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PHILIPPINE CITRUS FRUITS

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SIX PLATES AND TWO TEXT FIGURES

Citrus fruits belong to the family Rutaceæ, and they are native to southwestern Asia and adjacent islands. The Philippines are the habitat of a few varieties. The following varieties are indigenous to the Philippine Islands: [1]

Citrus hystrix var. *micrantha* (Wester); local name, biasong.
Citrus hystrix var. *microcarpa* (Wester) Merrill; local name, samuyau.
Citrus hystrix var. *southwickii* (Wester) Merrill; local name, limau.
Citrus hystrix var. *torosa* (Blanco) Wester; local name, kolobot.
Citrus hystrix var. *boholensis* Wester.
Citrus hystrix de Candolle; local name, kabuyau.
Citrus hystrix var. *macrophylla* (Wester) Merrill; local name, alimau.
Citrus limonia var. *pseudolimonum* (Wester) Merrill; local name, lombog.
Citrus aurantifolia var. *miaray* (Wester) Merrill.

According to Mr. P. J. Wester, of the Bureau of Agriculture, *Citrus webberi* Wester, *Citrus webberi* var. *montana* Wester, and *Citrus longispina* Wester are also indigenous to the Philippine Islands.

No evidence could be found that the Spaniards during their administration in the Philippines had introduced any of the Spanish, Italian, Japanese, Chinese, or other variety of citrus

[1] Merrill, E. D. Enumeration of Philippine Plants, Bureau of Science Publication 18, 2 (1923) 342–345.

into the Islands. To the Bureau of Agriculture belongs the credit of having introduced new varieties.

Table 1 enumerates the species and varieties of citrus that have been introduced from foreign countries each year, from 1910 to 1923. They were grown at the Lamao Experiment Station and the success of these growing tests indicates that the introduced forms are well adapted to Philippine conditions.

TABLE 1.—*Varieties of citrus trees introduced from foreign countries.*

P. I. No.	Year and kind.	Scientific name.	Origin.
	1910		
	Oranges:		
	Bahia	*Citrus sinensis* Osbeck	Australia.
	Mediterranean	do.	Do.
	Navalencia	do.	Do.
	Washington navel	do.	Do.
	Lemons:		
	Belair	*Citrus limonia* Osbeck	Do.
	Lisbon	do.	Do.
	Rough lemon	do.	Do.
	Villafranca	do.	Do.
	1911		
	Oranges:		
51	Valencia	*Citrus sinensis* Osbeck	Monrovia, California.
563	Sour Orange	*Citrus aurantium* Linnæus	Palm Beach, Florida.
1593	Do	do.	Vil. And. & Co. Paris.
	Lemons:		
691	Belair	*Citrus limonia* Osbeck	Sydney, Australia.
562		do.	Palm Beach, Florida.
693	Lisbon	do.	Australia.
559	Rough lemon	do.	Porto Rico.
819	Do	do.	Miami, Florida.
692	Villafranca	do.	Sydney, Australia.
	Limes:		
530		*Citrus aurantifolia* (Swingle)	Miami, Florida.
617		do.	Do.
619		do.	Do.
818	Lime	do.	Do.
	Pomelos:		
622	Pomelo	*Citrus maxima* Merrill	Java.
707	Do	do.	Sydney, Australia.
560		do.	Porto Rico.
	Mandarins:		
1267	Szinkom	*Citrus nobilis* Loureiro	Saharanpur, India.
1275	Unshiu	do.	Do.
	1912		
	Oranges:		
1720	Bahia	*Citrus sipensis* Osbeck	Australia.
706	Bahia navel	do.	Do.
1717	Buckeye navel	do.	Do.
1260	Excelsior	do.	Saharanpur, India.
1701	Holdfast	do.	Australia.
1638	Japanese orange	*Citrus aurantium* Linnæus	Do.

TABLE 1.—*Varieties of citrus trees introduced from foreign countries*—Continued.

P. I. No.	Year and kind.	Scientific name.	Origin.
	1912		
	Oranges—Continued.		
1719	Jaffa	*Citrus aurantium* Linnæus	Australia.
1637	Do	do	United States.
1258	Do	do	Saharanpur, India.
1722	Joppa	do	Australia.
1714	Larrantta	do	Do.
1259	Malta blood	do	Saharanpur, India.
1743	Mediterranean	do	Australia.
1705	Do	do	Do.
1916	Majorca	do	Oneco, Florida.
1742	Navalencia	do	Australia.
1635	Pineapple	do	United States.
2406	Pongkan	do	Formosa, Japan.
1917	Ruby	do	Oneco, Florida.
1639	Do	do	United States.
1277	Seville	do	Saharanpur, India.
1270	St. Michael's blood	*Citrus sinensis* Osbeck	Do.
1721	St. Michael	do	Australia.
740	Sweet	do	California, U. S.
1706	Valencia	do	Do.
1634	Do	do	United States.
1711	Washington navel	do	Australia.
1636	Do	do	United States.
1744	Do	do	Australia.
1266	Whitaker	do	Saharanpur, India.
1709	White siletta	do	Australia.
1715	Do	do	Do.
1645		do	Hongkong, China.
1736		do	Do.
2344		do	Ogasawara Island.
1448		do	Florida, U. S.
1264	Sour Florida	*Citrus aurantium* Linnæus	Saharanpur, India.
2357	Sour orange	do	Miami, Florida.
1779	Do	do	Do.
1453	Do	do	Do.
2426	Do	do	Do.
1440		do	Florida, U. S.
	Lemons:		
1704	Bengal	*Citrus limonia* Osbeck	Australia.
1782		do	Hongkong, China.
1703	Lisbon variegated	do	Australia.
1091	Rough lemon	do	Miami, Florida.
1710	Sicily	do	Australia.
1712	Thornless	do	Do.
1702	Villafranca	do	Do.
	Limes:		
1708	Tahiti	*Citrus aurantifolia* Swingle	Do.
936		do	U. S. Dept. of Agriculture.
980		do	Miami, Florida.

TABLE 1.—*Varieties of citrus trees introduced from foreign countries*—Continued.

P. I. No.	Year and kind.	Scientific name.	Origin.
	1912		
	Pomelos and grapefruits:		
1333	Eilen grapefruit	*Citrus maxima* Merrill	Oneco, Florida.
1334	Pernambuco grapefruit	do	Do.
1646	Pomelo	do	Hongkong, China.
2819	Pomelo red	do	Calcutta, India.
1995	Siamese (seedless)	do	Bangkok, Siam.
2177	Siamese	do	Do.
2361	Siamese (seedless)	do	Do.
2300	Stewart	do	Florida, U. S.
1713	Triumph	do	Australia.
	Mandarins:		
1265	China	*Citrus nobilis* Loureiro	Saharanpur, India.
1647		do	Hongkong, China.
1913		do	Queensland, Australia.
2346	Coolie	do	Hongkong, China.
1918	Dancy	do	Oneco, Florida.
1271	Kishiu	do	Saharanpur, India.
1272	Konda narum	do	Do.
1256	Ladu	do	Do.
1257	Omikinkan	do	Do.
1335	Oneco	do	Oneco, Florida.
1261	Orange mandarin	do	Saharanpur, India.
1263	Sikkim	do	Do.
1262	Suntara common	do	Do.
1276	Suntara nagpur	do	Do.
	Citrons:		
1278	Finger	*Citrus medica* Linnæus	Do.
1716	Common citron	do	Australia.
	Citrus hybrids:		
1948	Sampson tangelo (tangerine × grapefruit).	*Citrus* hybrid	Marathon, Florida.
1618	Do	do	U. S. Dept. of Agriculture.
	Citrus species:		
1278	Finger	*Citrus* sp	Saharanpur, India.
1269	Kaula	do	Do.
2246		do	West Coast, Borneo.
1268	Malta	do	Saharanpur, India.
1273	Natsu-daidai	do	Do.
2407	Sea Kam	do	Formosa, Japan.
1274	Vanille	do	Saharanpur, India.
2408	Tang Kam	do	Do.
	1913		
	Oranges:		
2705	Bessie	*Citrus sinensis* Osbeck	Florida, U. S.
2698	Boone	do	Do.
3100	Buckeye navel	do	Hongkong, China.
2895	Cajel	do	Guam.
2709	Centennial	do	Florida, U. S.
2708	Du Roi	do	Do.
3886	Do	do	Do.

TABLE 1.—*Varieties of citrus trees introduced from foreign countries*—Continued.

P. I. No.	Year and kind.	Scientific name.	Origin.
	1913		
	Oranges—Continued.		
2689	Enterprise (seedless)	*Citrus sinensis* Osbeck	Florida, U. S.
2685	Everbearing	do.	Do.
2701	Foster	do.	Do.
2691	Homosassa	do.	Do.
3101	Do	do.	Do.
3878	Kiowan	do.	Bangkok, Siam.
2694	Majorca	do.	Florida, U. S.
2688	Maltese oval	do.	Do.
2697	Maltese blood	do.	Do.
3104	Do	do.	Hongkong, China.
2704	Magnum bonum	do.	Florida, U. S.
2699	Madam Vinous	do.	Do.
2692	Nonpareil	do.	Do.
2706	Old vine	do.	Do.
2707	Paperind	do.	Do.
3103	Parramotta	do.	Do.
2695	Parson Brown	do.	Do.
2686	Pineapple	do.	Do.
3102	St. Jago	do.	Calcutta, India.
2696	Tardiff	do.	Florida, U. S.
3843		do.	Saigon, Indo China.
2662	Sour orange	*Citrus aurantium* Linnæus	Florida, U. S.
3255	Do	do.	Porto Rico.
2678	Do	do.	Zanzibar.
2511	Do	do.	Florida, U. S.
	Lemons:		
3898	Lamb's lemon	*Citrus limonia* Osbeck	Oneco, Florida.
3590	Lemon	do.	Hongkong, China.
	Limes:		
2822	Kagzi country	*Citrus aurantifolia* Swingle	Calcutta, India.
2823	Kagzi China	do.	Do.
2824	Kagzi Narengi	do.	Do.
2825	Pati country	do.	Do.
2882	Pati China	do.	Do.
2826	Sarvati	do.	Do.
	Pomelos:		
2687	Duncan	*Citrus maxima* Merrill	Florida, U. S.
3884	Foster	do.	Do.
3877	Hao Phaang	do.	Do.
2700	McCarthy	do.	Do.
3882	Do	do.	Do.
4121	Do	do.	Do.
2690	Marsh (seedless)	do.	Do.
3874	Nakoin chaisi	do.	Bangkok, Siam.
3875	Do	do.	Do.
3876	Do	do.	Do.
2819	Red pomelo	do.	Calcutta, India.
3384	Saigon	do.	Saigon, Indo China.
3438	Seedless pomelo	do.	Bangkok, Siam.

TABLE 1.—*Varieties of citrus trees introduced from foreign countries*—Continued.

P. I. No.	Year and kind.	Scientific name.	Origin.
	1913		
	Pomelos—Continued.		
3390	Siamese	*Citrus maxima* Merrill	Bangkok, Siam.
3389	Siamese (seedless)	do	Do.
3440	Siamese pomelo	do	Do.
3441	Do	do	Do.
3442	Do	do	Do.
2820	White pomelo	do	Calcutta, India.
3391	Yugelar	do	Bangkok, Siam.
3392	Do	do	Do.
2524		do	Japan.
	Mandarins:		
2984	Chinese	*Citrus nobilis* Loureiro	Hongkong, China.
2693	King	do	Florida, U. S.
3883	Oneco	do	Oneco, Florida.
3387		do	Saigon, Indo China.
	Citrons:		
3836		*Citrus medica* Linnæus	Do.
3837		do	Do.
	Citrus hybrids:		
3256	Bitter sweet	*Citrus* hybrid	Porto Rico.
3897	Tangerine (mandarin)	do	Oneco, Florida.
3884	Sampson tangelo (tangerine × grapefruit)		
3885	Do	*Citrus* hybrid	Oneco, Florida.
3886	Do	do	Do.
	Citrus species:		
3385		*Citrus* sp	Saigon, Indo China.
3838		do	Do.
3839		do	Do.
3386		do	Do.
3842		do	Do.
3833		do	Do.
3841		do	Do.
3844		do	Do.
3834		do	Do.
3835		do	Do.
2523		do	Ogasawara, Japan.
	1914		
	Oranges:		
4717	Brown	*Citrus sinensis* Osbeck	Florida, U. S.
4785	Blood orange	do	New South Wales, Australia.
4124	Carleton	do	Florida, U. S.
1807	Coolie	do	Hongkong, China.
4120	Du Roi	do	Florida, U. S.
4119	Dugat	do	Do.
4126	Foster	do	Do.
4783	Homosassa	do	Sydney, Australia.
5078	Keola	*Citrus* sp	Calcutta, India.
4123	Magnum bonum	*Citrus sinensis* Osbeck	Florida, U. S.

TABLE 1.—*Varieties of citrus trees introduced from foreign countries*—Continued.

P. I. No.	Year and kind.	Scientific name.	Origin.
	1914		
	Oranges—Continued.		
4782	Parramotta	*Citrus* sp	Sydney, Australia.
4117	Parson Brown	*Citrus sinensis* Osbeck	Florida, U. S.
4788	St. Jago	do	Australia.
4884		do	Cochin-China.
	Lemons:		
4804	African sweet	*Citrus limonia* Osbeck	Queensland, Australia.
4883		do	Cochin-China.
5175		do	Japan.
	Limes:		
5072	Alachi	*Citrus aurantifolia* Swingle	Calcutta, India.
5067	Cora	do	Do.
3669	Everglade	do	United States.
5068	Kagzi	do	Calcutta, India.
5070	Kalamba	do	Do.
3670		do	U. S. Dept. of Agriculture.
5069	Kagzi	do	Calcutta, India.
5073	Pati	do	Do.
5071	Sarvati	do	Do.
4122	Tahiti	do	Florida, U. S.
5176		do	Japan.
	Pomelos and grapefruits:		
5076	Hazareh pomelo	*Citrus maxima* Merrill	Calcutta, India.
5074	Kalsia	do	Do.
1707	Marsh grapefruit (seedless).	do	Australia.
4121	McCarthy	do	Florida, U. S.
4125	Royal grapefruit	do	Do.
5075	Society's pomelo	do	Calcutta, India.
4118	Walters grapefruit	do	Florida, U. S.
5170		do	Japan.
	Mandarins:		
4785	Blood orange	*Citrus* sp	New South Wales, Australia.
4787	Cantor	do	Do.
4784	Ellendale beauty mandarin.	do	Do.
5174		*Citrus nobilis* Loureiro	Japan.
5173	Saagkam	do	Do.
4786	Scarlet mandarin	*Citrus* sp	New South Wales, Australia.
4812	Citrus hybrid: Sampson tangelo (tangerine × grapefruit).	*Citrus* hybrid	Washington, D. C.
	Citrus species:		
4811	King of Siam orange		
5077	Sikkim	*Citrus* sp	Calcutta, India.
5081		do	Do.
5082		do	Do.

TABLE 1.—*Varieties of citrus trees introduced from foreign countries*—Continued.

P. I. No.	Year and kind.	Scientific name.	Origin.
	1914		
	Citrus species—Continued.		
5169	----------	*Citrus* sp. ----------	Japan.
5171	----------	----do. ----------	Do.
5172	----------	----do. ----------	Do.
	1915		
	Oranges:		
5151	Cajel ----------	*Citrus sinensis* Osbeck ----------	Guam.
5149	Lalangha magas. ----------	----do. ----------	Do.
5352	----------	----do. ----------	Java.
	Lemons:		
5148	Limon real ----------	*Citrus excelsa* Wester ----------	Guam.
5150	Limon China ----------	*Citrus* sp ----------	Do.
	Limes:		
5184	Kusaie ----------	*Citrus aurantifolia* Swingle ----------	Honolulu, Hawaii.
5182	Do ----------	----do. ----------	Japan.
5183	Low's seedless ----------	----do. ----------	Honolulu, Hawaii.
5186	Makawao ----------	----do. ----------	Do.
5163	Tahiti ----------	----do. ----------	Do.
5176	Lime ----------	----do. ----------	Japan.
	Pomelos:		
5167	Whitney's imperial pomelo.	*Citrus maxima* Merrill ----------	Honolulu, Hawaii.
5185	Do ----------	----do. ----------	Do.
5187	Mandarin: Willow leaved ----	*Citrus nobilis* Loureiro ----------	Do.
5236	Citron: Cidra ----------	*Citrus medica* Linnæus ----------	British North Borneo.
	1916		
	Lemons:		
5686	Lemon ----------	*Citrus* sp ----------	Costa Rica.
5690	Sweet lemon. ----------	----do. ----------	Do.
	Pomelos:		
5607	Hirado Buntan. ----------	*Citrus maxima* Merrill ----------	Nagasaki, Japan.
5550 to 6004	Citrus hybrids [a] ----------	*Citrus* hybrid ----------	Washington, D. C.
	1917		
6005	Pomelo: Chinese pomelo ----	*Citrus maxima* Merrill ----------	Do.
	Citrus hybrids:		
6060	Citrange (*Poncirus trifoliata*). [b]	*Citrus* hybrid ----------	Do.
6061 to 6064	Citrangelo (citrange × grapefruit).	----do. ----------	Do.
6065	Citrange (*Poncirus trifoliata* × orange).	----do. ----------	Do.
6066	Citrangelo (citrange × grapefruit).	----do. ----------	Do.

[a] There is no record as to the species that were crossed.
[b] *Citrus trifoliata* is now *Poncirus trifoliata*.

TABLE 1.—*Varieties of citrus trees introduced from foreign countries*—Continued.

P. I. No.	Year and kind.	Scientific name.	Origin.
	1917		
	Citrus hybrids—Continued.		
6067	Citrangemon (citrange × lemon).	*Citrus* hybrid	Washington, D. C.
6068	Citrangedin (citrange × calamondin).	do.	Do.
6069	Do	do.	Do.
6070	Citrangime (citrange × lime).	do.	Do.
6071	Citrangor (citrange × orange).	do.	Do.
6072	Do	do.	Do.
6073	Citranguma (citrange × Satsuma).	do.	Do.
6074	Do	do.	Do.
6075 to 6082	Citradia (*Poncirus trifoliata* × sour orange).	do.	Do.
6083 to 6090	Citrandarin (*Poncirus trifoliata* × mandarin).	do.	Do.
6091 to 6102	Citrumelo (*Poncirus trifoliata* × grapefruit).	do.	Do.
6103	Citrunshu (*Poncirus trifoliata* × Satsuma).	do.	Do.
6104	Do	do.	Do.
6105	Citrumquat (*Poncirus trifoliata* × kumquat).	do.	Do.
6106	Do	do.	Do.
6107	Citrange (*Poncirus trifoliata* × orange).	do.	Do.
6108	Do	do.	Do.
6109	Do	do.	Do.
6110	Citrange seedless (Rusk) (*Poncirus trifoliata* × orange).	do.	Do.
6111	Citrange seedless (Colman) (*Poncirus trifoliata* × orange).	do.	Do.
6112	Citrange seedless (Morton) (*Poncirus trifoliata* × orange).	do.	Do.
6113	Citrange seedless (Savage) (*Poncirus trifoliata* × orange).	do.	Do.
6114	Citrange seedless (White) (*Poncirus trifoliata* × orange).	do.	Do.

TABLE 1.—*Varieties of citrus trees introduced from foreign countries*—Continued.

P. I. No.	Year and kind.	Scientific name.	Origin.
	1917		
	Citrus hybrids—Continued.		
6115	Faustrimedin (Australian finger lime × calamondin orange).	*Citrus* hybrid	Washington, D. C.
6116	Do	do	Do.
6117 to 6126	Faustrime (Australian finger lime × lime).	do	Do.
6127 6128 6129	Faustrimon (Australian finger lime × lemon).	do	Do.
6130 to 6135	Tangelo (Oneco orange × grapefruit); (Clementine orange × grapefruit); (tangerine × grapefruit); (mandarin × grapefruit).	do	Do.
6136	Oranguma (orange × Satsuma).	do	Do.
6137	Orangelo (orange × grapefruit).	do	Do.
6138	Sapodia (sour pomelo × sour orange).	do	Do.
6141	Citrangequat (citrange × kumquat).	do	Do.
6139	Sapomaldin (sour pomelo × calamondin).	do	Do.
6140	Do	do	Do.
6142	Citrangequat (citrange × kumquat).	do	Do.
6143	Citrangor (citrange × orange).	do	Do.
6144	Do	do	Do.
6145	Do	do	Do.
6146	Citrangime (citrange × lime).	do	Do.
6147	Citrangemon (citrange × lemon).	do	Do.
6148	Do	do	Do.
6149	Citranguma (citrange × Satsuma).	do	Do.
6150	Do	do	Do.
6151 to 6154	Citrangedin (citrange × calamondin).	do	Do.
6155 to 6171	Citrangelo (citrange × grapefruit).	do	Do.
6172	Citrangor (citrange × orange).	do	Do.

TABLE 1.—*Varieties of citrus trees introduced from foreign countries*—Continued.

P. I. No.	Year and kind.	Scientific name.	Origin.
	1917		
	Citrus hybrids—Continued.		
6173	Citrangor (citrange × orange).	*Citrus* hybrid	Washington, D. C.
6174 to 6178	Citrumelo (*Poncirus trifoliata* × grapefruit).	do	Do.
6179 to 6201	Citrange (*Poncirus trifoliata* × orange).	do	Do.
6202 to 6210	Citrandarin (*Poncirus trifoliata* × mandarin).	do	Do.
6211	Citrumelo (*Poncirus trifoliata* × grapefruit).	do	Do.
6212	Do		
6213	Citrunshu (*Poncirus trifoliata* × Satsuma).	do	Do.
6214 to 6224	Citremon (*Poncirus trifoliata* × lemon).	do	Do.
6225	Sour lime (no *trifoliata* blood; miscellaneous).	do	Do.
6226	Lemonime (lemon × lime).	do	Do.
6227	Lemonquat (lemon × kumquat).	do	Do.
6228 to 6231	Mandor		
6232 to 6246	Mandelo (mandarin × grapefruit).	do	Do.
6247 to 6250	Orangelo (orange × grapefruit).	do	Do.
6251 to 6256	Oranguma (orange × Satsuma).	do	Do.
6257	Soporin (sour pomelo × king of Siam).	do	Do.
6268	Do	do	Do.
6269 to 6274	Sopodia (sour pomelo × sour orange).	do	Do.
6275	Tangeruma (tangerine × Satsuma).	do	Do.
6276	Tangelorin (tangerine × grapefruit) × king of Siam.	do	Do.
6277	Do	do	Do.

TABLE 1.—*Varieties of citrus trees introduced from foreign countries*—Continued.

P. I. No.	Year and kind.	Scientific name.	Origin.
	1917		
	Citrus hybrids—Continued.		
6278	Citrunshu (*Poncirus trifoliata* × Satsuma).	*Citrus* hybrid	Washington, D. C.
6279	Soporia (sour pomelo × king of Siam).	do	Do.
6280	Citrangor (citrange × orange).	do	Do.
6281	Citrangelo (citrange × grapefruit).	do	Do.
6282	Citrange (*Poncirus trifoliata* × orange).	do	Do.
6283	Citrumelo (*Poncirus trifoliata* × grapefruit).	do	Do.
6284	Citrange (*Poncirus trifoliata* × orange).	do	Do.
6291 to 6300	Citrangedin (citrange × calamondin).	do	Do.
6301	Citrangequat (citrange × kumquat).	do	Do.
6302	Do	do	Do.
6303	Citrangemon (citrange × lemon).	do	Do.
6304 to 6316	Citrangelo (citrange × grapefruit).	do	Do.
6317	Citremon (*Poncirus trifoliata* × lemon).	do	Do.
6318	Do	do	Do.
6319	Citrunshu (*Poncirus trifoliata* × Satsuma).	do	Do.
6320	Citremon (*Poncirus trifoliata* × lemon).	do	Do.
6321	Do	do	Do.
6322	Citrunshu (*Poncirus trifoliata* × Satsuma).	do	Do.
6323	Citremon (*Poncirus trifoliata* × lemon).	do	Do.
6351	Citrunshu (*Poncirus trifoliata* × Satsuma).	do	Do.
6352	Tangelorin (tangerine × grapefruit) × king of Siam.	do	Do.
6353	Citremon (*Poncirus trifoliata* × lemon).	do	Do.
6354	Citrangelo (citrange × grapefruit).	do	Do.
6355	Citraldin (*Poncirus trifoliata* × calamondin).	do	Do.

TABLE 1.—*Varieties of citrus trees introduced from foreign countries*—Continued.

P. I. No.	Year and kind.	Scientific name.	Origin.
	1917		
	Citrus hybrids—Continued.		
6356	Citremon (*Poncirus trifoliata* × lemon).	*Citrus* hybrid	Washington, D. C.
6357	Citrangelo (citrange × grapefruit).	do.	Do.
6358	Clemelo (clementine orange × grapefruit).	do.	Do.
6359	Do	do.	Do.
6360	Do	do.	Do.
6361	Faustrimedin (Australian finger lime × calamondin orange).	do.	Do.
6362	Do	do.	Do.
6363	Limedin (lime × calamondin orange).	do.	Do.
6364	Clemelo (clementine orange × grapefruit).	do.	Do.
6365	Do	do.	Do.
6366	Do	do.	Do.
6367	Faustrimedin (Australian finger lime × calamondin orange).	do.	Do.
6368	Limelo (lime × grapefruit)	do.	Do.
6369	Faustrime (Australian finger lime × lime).	do.	Do.
6370	Faustrimedin (Australian finger lime × calamondin orange).	do.	Do.
6371 to 6390	Clemelo (clementine orange × grapefruit).	do.	Do.
6391	Tangelo (mandarin × pomelo).	do.	Do.
6392	Clemelo (clementine orange × grapefruit).	do.	Do.
6393	Tangelo (mandarin × pomelo).	do.	Do.
6394	Clemelo (clementine orange × grapefruit).	do.	Do.
6395 to 6420	Tangelo (mandarin × pomelo).	do.	Do.
6421	Siamelo (king of Siam × grapefruit).	do.	Do.
6422	Do	do.	Do.
6423	Tangelo (mandarin × pomelo).	do.	Do.
6424	Do	do.	Do.
6425	Orangelo (orange × grapefruit).	do.	Do.

TABLE 1.—*Varieties of citrus trees introduced from foreign countries*—Continued.

P. I. No.	Year and kind.	Scientific name.	Origin.
	1917		
	Citrus hybrids—Continued.		
6426	Orangelo (orange × grapefruit).	*Citrus* hybrid	Washington, D. C.
6427	Siamelo (king of Siam × grapefruit).	do	Do.
6428	Do	do	Do.
6429	Orangelo (orange × grapefruit).	do	Do.
6430	Siamelo (king of Siam × grapefruit).	do	Do.
6431	Do	do	Do.
6432	Orangelo (orange × grapefruit).	do	Do.
6433	Do	do	Do.
6434	Do	do	Do.
6435	Siamelo (king of Siam × grapefruit).	do	Do.
6436	Orangelo (orange × grapefruit).	do	Do.
6437	Do	do	Do.
6438	Do	do	Do.
6439 to 6447	Oranguma (orange × Satsuma).	do	Do.
6448 to 6451	Tangelolo (tangerine × grapefruit) × grapefruit.	do	Do.
6452	Tangelorin (tangerine × grapefruit) × king of Siam.	do	Do.
6453	Tangelolo (tangerine × grapefruit) × grapefruit.	do	Do.
6454	Do	do	Do.
6455	Tangelorin (tangerine × grapefruit) × king of Siam.	do	Do.
6456	Tangelolo (tangerine × grapefruit) × grapefruit.	do	Do.
6457	Do	do	Do.
6458	Do	do	Do.
6459	Tangelorin (tangerine × grapefruit) × king of Siam.	do	Do.
6460	Orangelo (orange × grapefruit).	do	Do.
6460	Tangelolo (orange × grapefruit).	do	Do.
6462 to 6467	Satsumelo (Satsuma × grapefruit).	do	Do.

TABLE 1.—*Varieties of citrus trees introduced from foreign countries*—Continued.

P. I. No.	Year and kind.	Scientific name.	Origin.
	1917		
	Citrus hybrids—Continued.		
6468	Tangelorin (tangerine × grapefruit) × king of Siam.	*Citrus* hybrid	Washington, D. C.
6469	Satsumelo (Satsuma × grapefruit).	do.	Do.
6470 to 6475	Tangelorin (tangerine × grapefruit) × king of Siam.	do.	Do.
6476 to 6490	Satsumelo (Satsuma × grapefruit).	do.	Do.
6491	Oranguma (orange × Satsuma).	do.	Do.
6492	Do	do.	Do.
6493	Satsumelo (Satsuma × grapefruit).	do.	Do.
6494	Calashu (calamondin × Satsuma).	do.	Do.
6495	Satsumelo (Satsuma × grapefruit).	do.	Do.
6496 to 6503	Oranguma (orange × Satsuma).	do.	Do.
	1918		
6590	Mandarin: Kiriki unshiu	*Citrus nobilis* Loureiro	Do.
	Citrus hybrids:		
6505 to 6513		*Citrus* hybrid	Little River, Florida.
6617 to 6626		do.	Washington, D. C.
	Miscellaneous:		
6587	Ikeda	*Citrus* sp.	Do.
6604		*Citrus trifoliata*	China.
	1919		
6570	Orange: Chukaa	*Citrus sinensis* Osbeck	Hongkong.
	Mandarins:		
6569	Pongkaa	*Citrus nobilis* Loureiro	Do.
6571	Sunkit	do.	Do.
6946 to 6957	Citrus hybrids	*Citrus* hybrid	Washington, D. C.
	Citrus species:		
6995	Djeroek manis	*Citrus* sp.	Java.
6996	Djeroek nipis	do.	Do.
6997	Djeroek garoet	do.	Do.

TABLE 1.—*Varieties of citrus trees introduced from foreign countries*—Continued.

P. I. No.	Year and kind.	Scientific name.	Origin.
	1920		
7217	Lemon: Rough lemon	*Citrus limonia* Osbeck	Florida, U. S.
7143	Lime: Othaheite lime	*Citrus aurantifolia* Swingle	Japan.
7229	Pomelo: Seedless pomelo	*Citrus maxima* Merrill	Calcutta, India.
7227	Mandarin: Sikkim	*Citrus nobilis* Loureiro	Do.
	Citrus species:		
7142	Matsu Mikan	*Citrus* sp	Japan.
7228	Butwal	do	Calcutta, India.
7288		do	Canton, China.
	Miscellaneous:		
7239	Citrus moi		Do.
7309		*Citrus trifoliata*	Japan.
	1921		
	Lemons:		
7531	Rough lemon	*Citrus limonia* Osbeck	Do.
7619	Eureka	do	California.
7693	Lemon	do	Washington, D. C.
7719	Lime: Thornless lime	*Citrus aurantifolia* Swingle	Soledad Cienfuegos, Cuba.
7541	Pomelo	*Citrus maxima* Merrill	Japan.
	Citrus hybrids:		
7786	Rusk citrange (*Poncirus trifoliata* × citrange).		Washington, D. C.
7787	Citrangequat (citrange × kumquat).		Do.
7788			
7789			Do.
7242	Citrus species: Matsu Mikan	*Citrus* sp	Yokohama, Japan.
	1922		
8264	Lemon	*Citrus limonia* Osbeck	United States.
	1923		
	Mandarins:		
8315	Mandarin	*Citrus nobilis* Loureiro	Canton, China.
8316	Do	do	Do.

Table 2 gives the citrus fields containing the different kinds of citrus, most of which were imported, now growing at the Lamao Experiment Station. The dates of planting, flowering, and fruiting, the number of trees of each kind bearing, and the number of fruits harvested in 1923 are also included in the table. The names of some kinds imported and given in Table 1 are not included in Table 2, because the plants died shortly after arrival or were dead when received. Table 3 shows the citrus hybrids growing in Field N.

213007——2

TABLE 2.—*Citrus fields at Lamao Experiment Station, Bataan Province, Luzon.*

[Data from the Philippine Bureau of Agriculture.]

FIELD A

P. I. No.	Scientific and common name of scion.[a]	Stock.[b]	Growing trees.		Planted.	Flowered.	Fruited.	Trees bearing fruit.		Fruits harvested, 1923
			1922	1923				1922	1923	
	Citrus aurantifolia:									
901	Dayap	O	2	2	1912	Feb. 23; May 9, 1923.	Feb. 29; May 15, 1923.	2	2	27
902	Do	O	1	1	do	do	do	1	1	16
1749	Lime	O	2	2	do	do	do	2	2	150
2182	Do		1	2	do	do	do	1	1	10
2882	Pati China	P and Cn			1922; 1923					
1708	Tahiti	Cn		2	Apr. 13, 1923					
	Citrus aurantium:									
1264	Sour orange	P and M	2	2	1916; 1918					
1638	Do	O	2	2	1912	Feb. 23, 1923	Feb. 29, 1923	2	2	215
1013	*Citrus excelsa:* Limon real (marcot)		2	1	July 13, 1922					
	Citrus limonia:									
7619	Eureka	So and M		2	do					
7693	Lemon (seedling)		2	2	do					
708	Lisbon	P and M	1	2	1915; 1923					
3675	Rough lemon (marcot)		2	2	July 13, 1922					
	Citrus maxima:									
1633	Case pomelo	O	2	2	1912	Feb. 23, 1923	Feb. 29, 1923	2	2	83
6005	Chinese pomelo	P	1	1	1920					
1333	Ellen	O	2	2	1912	Feb. 23, 1923	Feb. 28, 1923	2	2	5

[a] Scion is the part inserted in budding or grafting.

[b] Abbreviations and their meanings are as follows: A, alsem; Cm, *Citrus medica;* Cmac, *Citrus macrophylla;* Cn, calamondin; Csp, *Citrus* species; Cw, *Citrus webberi;* K, kabuyao; L, lemon; Le, lime; Lr, limon real; M, mandarin; O, sweet orange; P, pomelo; So, sour orange.

TABLE 2.—*Citrus fields at Lamao Experiment Station, Bataan Province, Luzon*—Continued.

FIELD A—Continued.

P. I. No.	Scientific and common name of scion.	Stock.	Growing trees.		Planted.	Flowered.	Fruited.	Trees bearing fruit.		Fruits harvested, 1923
			1922	1923				1922	1923	
	Citrus maxima—Continued.									
2265	Lukban	O	2	1	1913	Feb. 23, 1923	Feb. 28, 1923	2	1	110
1707	Marsh	O	2	2	1912	do	do	1		
1631	Do	P	1	1	do	do	do	1	1	25
899	Oblong pomelo	O	1	1	do					
1334	Pernambuco	O and Csp	2	2	1912; 1916	Feb. 23, 1923	Feb. 28, 1923			
891	Pomelo	O	2	2	1912					
893	Do	O	1	1	do					
1713	Triumph	O	2	2	do	Feb. 23, 1923	Feb. 28, 1923	1	1	14
1632	Do	P	2	2	do	do	do	2	2	47
3392	Yugelar	P	1	1	1920					
	Citrus medica:									
------	Cotabato	Cn	------	2	Apr. 11, 1923					
------	Citrus medica	O	1	1	1913					
1716	Citron	O	1	2	1914	Feb. 23, 1923	Feb. 30, 1923	1	1	5
848	Murill	O	2	2	1912; 1913	Apr. 10, 1923	Apr. 16, 1923	2	2	6
------	Yanzo (seedling)	------	2	2	June 15, 1921					
1718	*Citrus mitis:* Kalamondin	O	1	1	1912	Feb. 23, 1923	Feb. 28, 1923	1	1	165
6589	*Citrus miaray*	M	1	1	1920					
	Citrus nobilis:									
1265	China	Cw	1	1	1912	Apr. 29, 1923	May 5, 1923	1	1	2
1918	Dancy	------	1	1	1913					
1271	Kishiu	O	1	1	1912	Feb. 23, 1923	Feb. 28, 1923	1	1	35
1272	Konda narum	O and Cn	2	2	do					
1256	Ladu	Lr	1	1	1919					

1335	Oneco	O	4	3	1912; 1916	Feb. 23, 1923	Feb. 28, 1923	1	1	2
5143	Rafael	P	2	2	1921; 1922					
744	Tizon var. *papillaris*	O	1	1	1912					
	Do	Lr	2	2	1914; 1919					
	Citrus sinensis:									
1720	Bahia	O	1	1	1912	Feb. 23, 1923	Feb. 28, 1923	1	1	2
966	Cajel	O	2	2	do	do	do	2	2	7
1728	Cuyo	O	2	2	do	do	do	2	2	17
1260	Excelsior	O	1	2	1912; 1923	Feb. 23; May 29	Feb. 28; June 6	1	1	8
2685	Everbearing	Cw	2	2	1916					
1701	Holdfast	O	2	2	1912	Feb. 23, 1923	Feb. 28, 1923	2	2	12
56	Jaffa	O	1	1	do	do	do	1	1	23
1719	Do	O	2	2	do	do	do	2	2	7
1637	Do	O	2	2	do	do	do	2	2	11
1714	Larrantta	O	1	1	do	do	do	1	1	16
1705	Mediterranean [c]	O and Lr	2	2	do	do	do	2	1	76
1743	Do	Cw	1	2	1912; 1923					
1742	Navalencia	M	1	1	1912					
2365	Orange	K	1	1	do	Feb. 23, 1923	Feb. 28, 1923	1	1	1
1635	Pineapple	O and Cn	1	2	1912; 1923	do	do	1	1	116
1639	Ruby	O	2	2	1912	do	do	2	2	106
2114	Sawyer's navel	P	1	1	1918					
1277	Seville	O	1	2	1912; 1923	Feb. 23, 1923	Feb. 28, 1923	1	1	
1270	St. Michael	O	2	2	1912	do	do	2	2	330
1706	Valencia	O	2	2	do	do	do	2	2	24
51	Do	Cn and O	4	4	1917; 1912	do	do	3	3	12
1636	Washington navel	O and Cn	1	2	1912; 1923	do	do	1	1	14
1711	Do	O	1	1	1915					
1715	White siletta	O	2	2	1912	Feb. 23, 1923	Feb. 28, 1923	2	2	20
2049	*Citrus scuthwickii*	Cm	2	2	1913	do	do	2	2	

[c] One tree carried away by flood.

TABLE 2.—*Citrus fields at Lamao Experiment Station, Bataan Province, Luzon*—Continued.

FIELD A—Continued.

P. I. No.	Scientific and common name of scion.	Stock.	Growing trees.		Planted.	Flowered.	Fruited.	Trees bearing fruit.		Fruits harvested, 1923
			1922	1923				1922	1923	
	Citrus sp.:									
2264	Tambuyog	K	1	1	1919					
6539	Duroga	M	1	1	do.					
	Citrus hybrid:									
1948	Sampson tangelo (tangerine × pomelo)		1	2	1913					
1618	Do	P	2	2	do.	Feb. 23, 1923	Feb. 28, 1923	2	2	12
	Citrus webberi:									
853	Alsem	O and Lr	2	2	do.	do.	do.	2	2	
896	Kabugau, *Citrus webberi* var. *montana*	O	2	2	1912	do.	do.	2	2	28
2266	Do	O	1	2	1913	do.	do.	1	1	300
	FIELD B									
	Citrus aurantifolia:									
3670	Trinidad	Cn	2	2	1914	Feb. 23, 1923	Feb. 28, 1923	2	2	730
3669	Everglade	Cn	2	2	do.	do.	do.	2	2	777
	Citrus aurantium:									
2511	Florida	O	2	2	1915	do.	do.	1	1	10
2662	Sour orange	P	2	2	do.	do.	do.	2	2	105
2385	Do		2	2	do.	do.	do.	2	2	116
	Citrus excelsa:									
1009	Limon real (stock)		1	1	do.	do.	do.	1	1	
3388	Le Nestour	Lr	1	1	do.	do.	do.	1	1	5

	Citrus hystrix:									
3665	Kolobot, *Citrus hystrix* var. *torosa*	P	2	2	1918	do.	do.	1	1	8
3668	*Citrus hystrix* D. C.	Cn	1	1	1915	do.	do.	1	1	
3656	Kanci, *Citrus hystrix* var. *boholensis*	Lr	1	1	do.	do.	do.	1	1	
	Citrus limonia:									
7693	Lemon (seedling)		2	2	July 12, 1922					
3675	Rough lemon		2	2	July 13, 1922					
	Citrus maxima:									
	Chinese pomelo		1	1	1921					
2687	Duncan	P	2	2	1915	Feb. 23, 1923	Feb. 28, 1923	1	1	86
2690	Marsh		1	1	do.					
2700	McCarthy	P	1	1	do.					
3882	Do	So	2	2	do.	Feb. 23, 1923	Feb. 28, 1923	2	2	42
4121	Do	Cw	2	2	do.	do.	do.	2	2	63
6181	Native pomelo	P	2	2	1916					
2524	Pomelo	P	1	1	1915	Feb. 23, 1923	Feb. 28, 1923	1	1	14
4125	Royal	Cmac.	2	2	do.	do.	do.	2	2	4
3384	Saigon	P	2	2	do.	do.	do.	2	2	18
1995	Siamese	P	2	2	do.	do.	do.	1	1	14
3389	Do	P	1	1	1919					
3673	S. S. pomelo	O	1	1	1915	Feb. 23, 1923	Feb. 28, 1923	1	1	58
4118	Walter	So and O	2	2	do.	do.	do.	2	2	58
	S. S. pomelo	P	2	2	1917			1	1	1
3392	Yugelar	P	1	1	1915					
3391	Do	P	1	1	do.	Feb. 23, 1923	Feb. 28, 1923	1	1	1
7541	*Citrus maxima*		3	3	July 13, 1922					
2502	*Citrus micrantha:* Biasong	O	1	1	1915	Feb. 23; May 29	Feb. 28; May 6	1	1	300
	Citrus mitis:									
2355	Kalamondin	P	1	1	do.	do.	do.	1	1	530
2513	Do	Lr and Cn	2	2	do.	do.	do.	2	2	2,830
2332	Do	Lr	2	2	do.	do.	do.	2	2	548

TABLE 2.—*Citrus fields at Lamao Experiment Station, Bataan Province, Luzon*—Continued.

FIELD B—Continued.

P. I. No.	Scientific and common name of scion.	Stock.	Growing trees.		Planted.	Flowered.	Fruited.	Trees bearing fruit.		Fruits harvested, 1923
			1922	1923				1922	1923	
	Citrus nobilis:									
2693	King	P	2	2	1915	Feb. 23, 1923	Feb. 29, 1923	2	2	15
5173	Saagkam	Cn	2	2	1917	do.	do.	1	1	5
3383	*Citrus nobilis*	Lr	1	1	1915	do.	do.	1	1	15
	Citrus sinensis:									
3660	Balanga	Cn	2	2	do.	Feb. 23; May 29	May 29; June 6	2	2	148
2698	Boone	Cn	1	2	do.	Feb. 23, 1923	Feb. 29, 1923	1	1	30
4117	Brown	O	2	2	do.	do.	do.	2	2	41
2695	Do	Lr	2	2	do.	Feb. 23, May 29	do.	2	2	212
4124	Carleton	O	2	2	do.	Feb. 23, 1923	do.	2	2	140
4119	Dugat	Cw and Le	2	2	do.	Feb. 23; May 29	May 29; June 6	2	2	57
3886	Du Roi	So	1	1	do.	Feb. 23, 1923	Feb. 29, 1923	1	1	5
2689	Enterprise		1	2	do.	Feb. 23; May 29	do.	1	1	8
1259	Malta Blood	Lr	1	1	do.	Feb. 23, 1923	do.	1	1	147
2697	Maltese Blood	P	1	1	do.	Feb. 23; May 29	do.	1	1	3
2694	Majorca	Lr	1	2	do.	do.	do.	1	2	63
2568	Misamis	Lr	1	1	do.	do.	do.	1	1	110
4123	Magnum bonum	O	2	2	do.	Feb. 23, 1923	do.	2	2	122
2568	Native orange	Lr	1	1	do.	do.	do.	1	1	
2686	Pineapple	Cn	1	1	do.	Feb. 23; May 29	do.	1	1	104
5177	Pongkan	M	2	2	1917	Feb. 23, 1923	do.	2	2	84
2569	Valencia	Cn	1	1	1913					
2426	*Citrus sinensis*		1	1	1915					
1948	*Citrus* hybrid: Sampson tangelo (tangerine × pomelo).	P	1	1	do.					

	Citrus medica:									
------	Yanzo (seedling)	------	2	2	June 15, 1921	------	------	------	------	------
1716	Citron (marcot)	------	2	2	July 13, 1922	------	------	------	------	------
3671	*Citrus* sp	Cn	1	1	1915	Feb. 23, 1923	Feb. 29, 1923	1	1	5

FIELD C.

	Citrus aurantifolia:									
5163	Tahiti	O	2	2	1917	Feb. 23, 1923	Feb. 28, 1923	2	2	15
5176	Lime	P and Cn	2	2	1915	do	do	2	2	15
4827	Lombog	P	1	1	do	do	do	1	1	28
5184	Kusaie lime	P	1	1	1918	------	------	------	------	------
2662	*Citrus aurantium:* Sour orange	P	2	2	1915	Feb. 23, 1923	Feb. 28, 1923	2	2	25
8841	*Citrus excelsa:* Tanchau	P	1	1	do	do	do	1	1	0
	Citrus limonia:									
4804	Lemon	P	1	1	1918	do	do	------	------	------
5175	Do	C	2	2	1915	do	do	2	2	6
	Citrus hystrix:									
4830	Amontay	P	1	1	do	------	------	------	------	------
2494	Kabuyau	O	1	1	do	Feb. 23, 1923	Feb. 28, 1923	1	1	6
5189	Do	P	1	1	1918	do	do	1	1	13
4214	Kamugau	Lr	1	1	1915	do	do	1	1	------
4225	Kalooy	Lr	2	2	do	do	do	2	2	36
4824	Kanci, *Citrus hystrix* var. *boholensis*	P	1	1	do	do	do	1	1	------
5137	Kolobot, *Citrus hystrix* var. *torosa*	P	2	2	do	do	do	2	2	8
5165	Suangui, *Citrus hystrix* var. *torosa*	Cw	2	2	1917	Feb. 23; May 29	Feb. 28; June 6	2	2	64
	Citrus medica:									
4739	Citron	So	1	1	1915	May 29, 1923	June 6, 1923	1	1	------
------	Cidra	Cw	1	2	1915; 1923	------	------	------	------	------
4839	*Citrus longispina:* Tamisan	P	2	2	1915	Feb. 23, 1923	Feb. 28, 1923		1	------

[d] Carried away by flood.

TABLE 2.—*Citrus fields at Lamao Experiment Station, Bataan Province, Luzon*—Continued.

FIELD C—Continued.

P. I. No.	Scientific and common name of scion.	Stock.	Growing trees.		Planted.	Flowered.	Fruited.	Trees bearing fruit.		Fruits harvested, 1923
			1922	1923				1922	1923	
	Citrus maxima:									
2503	Boongon	O	1	1	1915					
4868	Kellogg	P	2	2	do.	Feb. 23, 1923	Feb. 28, 1923	2	2	16
3876	Nakoin	P	1	1	do.					
5103	Panuban	P	2	2	1918					
5144	Do	P	1	1	1915	Feb. 23, 1923	Feb. 28, 1923	1	1	3
5146	Do	P	1	1	do.					
5223	Pomelo	P	2	2	1917					
3442	Siamese	So	1	1	1915	May 29, 1923	June 6, 1923	1	1	
	Citrus mitis: Kalamondin		2	2	do.	Feb. 23, 1923	Feb. 28, 1923	2	2	1,144
	Citrus nobilis:									
1256	Ladu	P	1	1	do.					
5142	Laurel	P	2	1	1919					
5138	Malvar	Cw	2	2	1915					
2948	Mandarin	P and M	2	2	1917					
744	Molana, *Citrus nobilis* var. *molana*	Cn	1	1	1915					
3883	Oneco	Cw	2	2	1915; 1919					
1262	Suntara	P	2	2	1915					
745	Tizon, *Citrus nobilis* var. *papillaris* d	Lr	1	1	1918					8
5139	Ubay	P	2	2	do.					
	Citrus sinensis:									
4126	Foster	O	2	2	1915	Feb. 23, 1923	Feb. 28, 1923			46
1258	Jaffa	O	2	2	do.	do.	do.			19
5188	Orange	P	2	2	1917					
1266	Whitaker	P and Cn	2	2	1915	Feb. 23, 1923	Feb. 28, 1923	2	2	16

3885	*Citrus* hybrid: Sampson tangelo (tangerine × pomelo).	P	2	2	do					
5325	*Citrus* sp.	P	1	1	1917					
	Citrus webberi:									
5147	Alsem	P	1	2	1915					
5174	Kabugau, *Citrus webberi* var. *montana*	P	1	2	1918					
5497	Gauid, *Citrus webberi* var. *montana*	P	1	2	do					
5540	Lurad	P	2	2	do					
5102	*Citrus webberi*	P	2	2	do	Feb. 23, 1923	Feb. 28, 1923	2	2	24
	Citrus aurantifolia:									
741	Lime [e]		3	1	1913			3	1	
2500	Do		1		do			1		
3672	Do [f]		4	3	do			4	3	
2532	Do [e]		4	2	do			4	2	
975	Do		2	2	do					
2346	Do [f]		4	3	do			4	3	
901	Do		4	4	1914				2	
2190	Do [f]		4	3	do			1	1	
1400	Do		3	3	do					
	Citrus aurantium:									
1453	*Citrus aurantium*		4	4	1913					
1011	Do		4	4	do					
2357	Do		6	6	do			6	6	
1593	Do		4	4	1914			2	2	
7448	Do		3	3	do					
	Citrus excelsa:									
853	*Citrus excelsa*		3	3	1913					
741	Do [e]		6	4	do					
1009	Do [g]		2	2	do					

[d] Carried away by flood. [e] Two died of bark rot. [f] One died of bark rot. [g] Died of bark rot.

TABLE 2.—*Citrus fields at Lamao Experiment Station, Bataan Province, Luzon*—Continued.

FIELD C—Continued.

P. I. No.	Scientific and common name of scion.	Stock.	Growing trees.		Planted.	Flowered.	Fruited.	Trees bearing fruit.		Fruits harvested, 1923
			1922	1923				1922	1923	
	Citrus hystrix:									
790	*Citrus hystrix*		4	4	1913			4	4	
834	Do		5	5	do			2	2	
807	Do		9	8	do					
5129	Do		2	2	do					
3673	Do		5	5	do					
	Citrus limonia:									
	Rough lemon		5	5	do	Feb. 23, 1923	Feb. 28, 1923	1	1	20
1754	*Citrus limonia*		3	1	1915					
	Citrus longispina:									
2529	*Citrus longispina*		5	5	1913					
2528	Do		7	7	do					
	Citrus maxima:									
897	*Citrus maxima*		1	1	do					
5699	Do		2	2	do					
750	Do		3	3	do					
2461	Do		4	4	do					
3673	Do		1	1	do					
7421	Do		2	2	do					
2403	Do		4	4	1914					
1646	Do		2	2	do					
2372	*Citrus macrophylla*		4	4	1913					
	Citrus micrantha:									
	Citrus micrantha		1	1	do					
2502	Do		2	2	do					
1892	Do		4	3	1914					

	Citrus mitis:									
741	Kalamondin	2	2	1913	Oct 1 1922	Oct. 21, 1922	2	2	75
772	Do	4	4	do	Mar. 23, 1923	Mar. 28, 1923	4	4	2,350
2653	Do	4	4	1914	do	do	4	4	55
2651	Do	4	4	do	do	do	4	4	120
	Citrus medica:								
27	*Citrus medica*	1		1913					
790	Do	2	2	do					
5699	Do	1	1	do					
2499	Do	2	2	do					
2652	Do	1	1	1914					
	Citrus sinensis:								
706	Bahia	2	2	1913					
1260	Excelsior	1	1	do					
1258	Jaffa	1	1	do					
1259	Malta Blood	1	1	do	Feb. 23, 1923	Feb. 28, 1923	1	3	147
1743	Mediterranean	1	1	do					
1742	Navalencia	2	2	do	Feb. 23, 1923	Feb. 28, 1923	2	2	
740	Orange	4	4						
2344	Do	4	4						
2648	Do	4	4	1914					
2649	Do	4	4	do					
1636	Washington navel	2	2	1913					14
	Citrus southwickii:								
2526	Limau	4	4	do					
2517	Do	4	3	do	Feb. 23, 1923	Feb. 28, 1923	1		
2525	Do	6	6	do					
	Citrus webberi:								
	Citrus webberi	3	3	do	Feb. 23, 1923	Feb. 28, 1923	3	3	
789	Do	4	4	do	do	do	4	4	
2275	Do	4	4	do	do	do	4	4	
2363	Do	4	4	do	do	do	4	4	

[e] Two died of bark rot.

[f] One died of bark rot.

TABLE 2.—*Citrus fields at Lamao Experiment Station, Bataan Province, Luzon*—Continued.

FIELD C—Continued.

P. I. No.	Scientific and common name of scion.	Stock.	Growing trees.		Planted.	Flowered.	Fruited.	Trees bearing fruit.		Fruits harvested, 1923
			1922	1923				1922	1923	
	Citrus nobilis:									
1265	China		1	1	1913					2
1271	Kishiu		2	2	do.					35
1256	Ladu		2	2	do.					
1263	Sikkim		1	1	do.					
1262	Suntara		2	2	do.					
1267	Szinkom		2	2	do.	Feb. 23, 1923	Feb. 28, 1923	2	2	
2527	*Citrus nobilis*		4	4	do.					
	Do		4	4	do.					
5975	Do		1	1	do.					
2469	Do		4	4	do.					
2346	Do		4	4	do.					
2650	Do		4	4	1914					
2448	Do		4	4	do.					
1647	Do		4	4	do.					
	FIELD N.									
2346	*Citrus aurantifolia*		1	1	do.					
	Citrus aurantium:									
1453	*Citrus aurantium*		1	1	do.	Feb. 23, 1923	Feb. 28, 1923	1	1	
1448	Do		2	2	do.	do.	do.	2	2	
969	Do		8	8	do.	do.	do.	8	8	
920	Do		2	2	do.	do.	do.	2	2	

	Citrus excelsa:									
2655	*Citrus excelsa*	4	4	do	do	do	2	2		
970	Do[1]	4	3	do	do	do	3	3		
1013	Do	3	3	do	do	do	3	3		
833	Do	4	4	do	do	do	4	4	2	
853	Do	2	2	do						
	Citrus hystrix:									
	Citrus hystrix	2	2	do						
5699	Do	1	1	do						
790	Do	1	1	do						
834	Do	4	4	do			2	2		
	Citrus maxima:									
2257	*Citrus maxima*	2	2	do						
990	Do	2	2	1915						
2402	Do	4	4	do						
560	Do	1	1	do						
549	Do	1	1	do						
3035	Do	4	4	1917						
	Citrus medica:									
5699	*Citrus medica*	2	1	1914						
897	Do	1	1	do						
1010	Do	3	3	do						
840	Do	1	1	do						
	Do	1	1	do						
	Citrus mitis:									
2653	*Citrus mitis*	1	1	do	October 15, 1922; Mar. 23, 1923.	October 21, 1922; Mar. 28, 1923.	1	1	50	
2184	Do	4	4	do	do	do	4	4	210	
	Citrus nobilis:									
2527	*Citrus nobilis*	2	2	do						
2346	Do	3	3	do						

[1] One died of bark rot.

TABLE 2.—*Citrus fields at Lamao Experiment Station, Bataan Province, Luzon*—Continued.

FIELD N—Continued.

P. I. No.	Scientific and common name of scion.	Stock.	Growing trees.		Planted.	Flowered.	Fruited.	Trees bearing fruit.		Fruits harvested, 1923
			1922	1923				1922	1923	
	Citrus nobilis—Continued.									
2469	*Citrus nobilis*		1	1	1914					
2448	Do		8	8	do					
	Citrus sinensis:									
	Citrus sinensis		3	3	do					
923	Do		4	4	do					
1982	*Citrus* sp		4	4	do					
	Citrus webberi:									
2363	*Citrus webberi*		3	3	do	Feb. 23, 1923	Feb. 28, 1923	3	3	
789	Do		4	4	do	do	do	3	3	
2275	Do		3	3	do	do	do	3	3	
5698	Do		5	5	do	do	do	5	5	
5102	Do		5	5	do	do	do	4	4	
892	Do		3	3	do	do	do	3	3	

TABLE 3.—*Citrus hybrids in field N, Lamao Experiment Station.*

P. I. No.	Scientific and common name.	Stock.	Trees.		Year planted.
			1922	1923	
5550	*Citrus* hybrid	Pomelo	1	1	1917
5553	Do	do	1	1	1917
5555	Do	do	1	1	1917
5556	Do	do	1	1	1917
5557	Do	do	1	1	1917
5558	Do	do	1	1	1917
5561	Do	do	1	1	1917
5562	Do	do	1	1	1917
5565	Do	do	1	1	1917
5566	Do	do	1	1	1917
5567	Do	do	1	1	1917
5568	Do	do	1	1	1917
5569	Do	do	1	1	1917
5571	Do	do	1	1	1917
5572	Do	do	1	1	1917
5573	Do	do	1	1	1917
5574	Do	do	1	1	1917
5575	Do	do	1	1	1917
5578	Do	do	1	1	1917
5579	Do	do	1	1	1917
5580	Do	do	1	1	1917
5581	Do	do	1	1	1917
5582	Do	do	1	1	1917
5583	Do	do	1	1	1917
5584	Do	do	1	1	1917
5585	Do	do	1	1	1917
5586	Do	do	1	1	1917
5587	Do	do	1	1	1917
5588	Do	do	1	1	1917
5589	Do	do	1	1	1917
5590	Do	do	1	1	1917
5591	Do	do	1	1	1917
5592	Do	do	1	1	1917
5593	Do	do	1	1	1917
5594	Do	do	1	1	1917
5598	Do	do	1	1	1917
5599	Do	do	1	1	1917
5651	Do	do	1	1	1917
5663	Do	do	1	1	1917
6353	Clemelo (Clementine orange × grapefruit)	do	1	1	1915
5654	*Citrus* hybrid	do	1	1	1917
5655	Do	do	1	1	1917
5656	Do	do	1	1	1917
5657	Do	do	1	1	1917
5658	Do	do	1	1	1917
5662	Do	do	1	1	1917
5663	Do	do	1	1	1917
6376	Clemelo (Clementine orange × grapefruit)	do	1	1	1918
6375	Do	do	1	1	1918
5705	*Citrus* hybrid	do	1	1	1917
5706	Clemelo (Clementine orange × grapefruit)	do	1	1	1917

TABLE 3.—*Citrus hybrids in field N, Lamao Experiment Station*—Ctd.

P. I. No.	Scientific and common name.	Stock.	Trees.		Year planted.
			1922	1923	
5707	*Citrus* hybrid	Pomelo	1	1	1917
5709	Do	do	1	1	1917
6369	Faustremon (Australian finger lime × lime)	do	1	1	1918
6404	Tangelo (tangerine × pomelo)	do	1	1	1918
5712	*Citrus* hybrid	do	1	1	1917
6364	Clemelo (Clementine orange × grapefruit)	do	1	1	1918
6378	Do	do	1	1	1918
6716	*Citrus* hybrid	do	1	1	1917
6311	Citrangelo (citrange × grapefruit)	do	1	1	1918
6391	Tangelo (tangerine × pomelo)		1	1	1918
5720	*Citrus* hybrid	Pomelo	1	1	1917
5721	Do	do	1	1	1917
6774	Do	do	1	1	1918
5728	Do	do	1	1	1917
6397	Do	do	1	1	1918
6385	Tangelo (tangerine × pomelo)	do	1	1	1918
5734	*Citrus* hybrid	do	1	1	1917
5737	Do	do	1	1	1917
6356	Citremon (*Poncirus trifoliata* × lemon)	do	1	1	1918
6411	Tangelo (tangerine × pomelo)	do	1	1	1918
5759	*Citrus* hybrid	do	1	1	1917
------	Do		1	1	1917
5741	Do		1	1	1917
5744	Do		1	1	1917
5746	Do		1	1	1917
6451	Tangelo (tangerine × pomelo)	Pomelo	1	1	1918
6389	Clemelo (Clementine orange × grapefruit)	do	1	1	1918
5748	*Citrus* hybrid		1	1	1917
5755	Do		1	1	1917
5756	Do		1	1	1917
5757	Do		1	1	1917
5758	Do		1	1	1917
6320	Citremon (*Poncirus trifoliata* × lemon)	Pomelo	1	1	1918
6388	Clemelo (Clementine orange × grapefruit)	do	1	1	1918
6442	Oranguma (orange × Satsuma)	do	1	1	1918
6407	Tangelo (tangerine × pomelo)	do	1	1	1918
5770	*Citrus* hybrid	do	1	1	1917
5771	Do		1	1	1917
6317	Citremon (*Poncirus trifoliata* × lemon)	Pomelo	1	1	1917
5772	*Citrus* hybrid		1	1	1917
5773	Do		1	1	1917
5774	Do		1	1	1917
6408	Tangelo (tangerine × pomelo)	Pomelo	1	1	1918
5777	*Citrus* hybrid		1	1	1917
5778	Do		1	1	1917
5779	Do		1	1	1917
6423	Tangelo (tangerine × pomelo)	Pomelo	1	1	1918
5783	*Citrus* hybrid		1	1	1917
5784	Do		1	1	1917
5786	Do		1	1	1917
6787	Do		1	1	1918

TABLE 3.—*Citrus hybrids in field N, Lamao Experiment Station*—Ctd.

P. I. No.	Scientific and common name.	Stock.	Trees.		Year planted.
			1922	1923	
5790	*Citrus* hybrid		1	1	1918
6087	Citrandarin (*Poncirus trifoliata* × mandarin)		1	1	1918
6130	*Citrus* hybrid		1	1	1918
6110	Do		1	1	1918
6100	Citrumelo (*Poncirus trifoliata* × grapefruit)		1	1	1918
6111	*Citrus* hybrid		1	1	1918
6112	Do		1	1	1918
6113	Swingle's citrange (*Poncirus trifoliata*) × orange		1	1	1918
6082	Citradia (*Poncirus trifoliata* × sour orange)		1	1	1918
6088	Citrandarin (*Poncirus trifoliata* × mandarin)		1	1	1918
6108	Citrange (*Poncirus trifoliata* × orange)		1	1	1918
6075	Citradia (*Poncirus trifoliata* × sour orange)		1	1	1918
6099	Citrumelo (*Poncirus trifoliata* × grapefruit)		1	1	1918
6101	Do		1	1	1918
5956	*Citrus* hybrid	Mandarin	1	1	1918
5957	Do	do	1	1	1918
6136	Do		1	1	1918
6036	Citrandarin (*Poncirus trifoliata* × mandarin)		1	1	1918
6089	Do		1	1	1918
5947	*Citrus* hybrid	Pomelo	1	1	*1918
5955	Do	do	1	1	*1918
5948	Do	Mandarin	1	1	1918
6104	Citrunshu (*Poncirus trifoliata* × Satsuma)		1	1	1918
5961	*Citrus* hybrid	Mandarin	1	1	1918
5970	Do	do	1	1	1918
5922	Do	do	1	1	1918
5926	Do	do	1	1	1918
6078	Citradia (*Poncirus trifoliata* × sour orange)	do	1	1	1918
5918	*Citrus* hybrid	do	1	1	1918
5916	Do	do	1	1	1918
5965	Do	do	1	1	1918
5917	Do	do	1	1	1918
5553	Do	Pomelo	1	1	1918
5924	Do	Mandarin	1	1	1918
5937	Do	do	1	1	1918
5935	Do	do	1	1	1918
5954	Do	do	1	1	1918
5915	Do	do	1	1	1918
5909	Do	do	1	1	1918
5932	Do	do	1	1	1918
5946	Do	do	1	1	1918
5938	Do	do	1	1	1918
5930	Do	do	1	1	1918
5951	Do	do	1	1	1918
5913	Do	do	1	1	1918
5896	Do	do	1	1	1918
5903	Do	do	1	1	1918
5908	Do	do	1	1	1918
5897	Do	do	1	1	1918
5899	Do	do	1	1	1918

* May 25.

TABLE 3.—*Citrus hybrids in field N, Lamao Experiment Station*—Ctd.

P. I. No.	Scientific and common name.	Stock.	Trees.		Year planted.
			1922	1923	
5900	*Citrus* hybrid	Mandarin	1	1	1918
5962	Do	do	1	1	1918
5995	Do	do	1	1	1918
5914	Do	do	1	1	
5910	Do	do	1	1	
5912	Do	do	1	1	
5906	Do	do	1	1	
5904	Do	do	1	1	
5905	Do	do	1	1	
5881	Do	Pomelo	1	1	
5885	Do	do	1	1	
5883	Do	do	1	1	1918
5890	Do				
5884	Do				
5880	Do				
5655	Do				
5889	Do				
5892	Do				
5657	Do				
5886	Do				
5893	Do				
[b] 5950	Do		1	1	
5998	Do				
5991	Do				
5994	Do				
5894	Do				
5926	Do	Mandarin	1	1	1918
5859	Do	Pomelo	1	1	1918
5865	Do				
5659	Do				
[c] 5881	Do				
5870	Do				
5672	Do				
5852	Do	Pomelo	1	1	1918
5856	Do	do	1	1	1918
5855	Do	do	1	1	1918
5858	Do	do	1	1	1918
5873	Do	do	1	1	1918
5869	Do	do	1	1	1918
5876	Do	do	1	1	1918
5862	Do	do	1	1	1918
5871	Do	do	1	1	1918
5875	Do	do	1	1	1918

[b] Died of pink disease. [c] Died of bark rot.

It is remarkable that of 847 trees growing at the Lamao Experiment Station at the beginning of the year 1923 only 19 died; 3 of them were carried away by flood and 16 were destroyed by disease. Although many of the imported kinds are

susceptible to disease, with proper cultivation and care disease does not gain a strong foothold.

It has been observed[2] that different species of citrus have different degrees of susceptibility to various citrus diseases, and that even the different varieties of the same species vary in susceptibility. All but one of the varieties of *Citrus aurantifolia* were attacked by canker, and this disease was prevalent throughout the year. All except one of the varieties were attacked by bark rot, which was prevalent during the latter part of the dry season only. There was only one case of pink disease, and it occurred during the rainy season.

The varieties under *C. aurantium* were not attacked by pink disease or by bark rot, although one variety was slightly affected by the latter toward the close of the dry season. This variety was also more or less resistant to canker. No case of foot rot was observed, but mottled leaf was prevalent the year round.

Citrus excelsa was attacked by bark rot and by canker. Bark rot was observed during the latter part of the dry season, and canker was prevalent throughout the year. This species was not attacked by pink disease, foot rot, or mottled leaf; at least, no case was observed.

Citrus hybrids were not attacked by bark rot. Their resistance to canker varied; some were greatly affected and others but slightly, and two varieties were immune to it. Nine cases of pink disease were observed during the latter part of the rainy season and the early part of the dry season; three trees were killed by it.

The different varieties of *C. hystrix* were generally not attacked by bark rot. They were more or less resistant to canker. There was not a single case of pink disease or foot root. There were four cases of mottled leaf, which were observed during the latter part of the dry season.

Citrus limonia was more or less attacked by bark rot and canker. Bark rot prevailed during the latter part of the dry season and canker prevailed throughout the year. This species was resistant to pink disease. There was only one case of mottled leaf.

Citrus longispina was attacked by pink disease, by canker, and by foot rot. It was more or less resistant to mottled leaf.

[2] Annual Report of the Superintendent of Lamao Experiment Station to the Director of Agriculture for 1923.

Citrus maxima was more or less resistant to bark rot, but was attacked by canker; all of the varieties were affected throughout the year. It was also attacked by mottled leaf. There was only one case of pink disease.

Citrus medica was attacked by bark rot, more or less resistant to canker, and very resistant to pink disease, foot rot, and mottled leaf. Only one tree died of bark rot.

Citrus mitis was not attacked by pink disease, canker, or foot rot, and was somewhat resistant to bark rot. There were only one case of bark rot and two cases of mottled leaf.

Citrus nobilis was not attacked by pink disease or canker, was more or less resistant to bark rot, and was slightly attacked by mottled leaf and by foot rot. Only one case of foot rot and one of bark rot occurred.

Citrus sinensis was generally attacked by canker and by mottled leaf. There were three cases of pink disease and one case of foot rot. There were a few cases of mottled leaf of varying degrees during the latter part of the dry season.

Pink disease, foot rot, and mottled leaf did not affect any of the varieties of *Citrus southwickii*. They were not attacked by bark rot or canker.

The varieties of *Citrus webberi* were not attacked by foot rot or pink disease, and were more or less resistant to bark rot and canker. There were mottled leaf cases of slight degree throughout the year.

Aside from the diseases mentioned, there are several insect enemies which do considerable damage to Philippine citrus trees.

Mr. W. Schultze, entomologist of the Bureau of Science, considers that *Agrilus occipitalis* Eschscholtz, of the family Buprestidæ, is the insect most destructive to many species of citrus. The larvæ of this Coleoptera feed inside of the branches of the trees, which die as a result of the injuries. The larvæ of certain Lepidoptera, or butterflies, for example, *Papilio alphenor* Cramer and *Papilio rumanzovia* Eschscholtz, also feed on citrus, and sometimes do considerable damage, particularly to the young plants. Another destructive insect is a fly (probably the mango fruit fly, *Dacus ferrugineus*), which lays its eggs in the fruits; the larvæ feed on the flesh of the fruits, thus causing the latter to fall. The best remedy known is to gather the fallen fruits and bury them before the adult insects emerge in order to avoid the infection of other fruits. Still other enemies are the mealy bugs and the scale insects; a kerosene-emulsion spray is effective for checking these.

Table 4 shows production of the bearing citrus trees; that is, the actual yield of fruits per tree, the amount harvested, the number and calculated percentage of fruits dropping, and the age of each tree. The trees are grouped as to species and are arranged as to yield. In several tables and in the text the expression P. I. No. is used. This signifies the number given by the Bureau of Agriculture whenever a new plant is introduced.

TABLE 4.—*Production of bearing citrus trees at Lamao Experiment Station.*

P. I. No.	Row and tree Nos.	Scientific and common name.	Age.	Actual yield in fruits.		Fruits dropped.		Unaccountable losses.
				On tree.	Harvested.			
		Citrus aurantifolia:	*Yrs.*			*Number.*	*Per cent.*	
3669	R9 – T3	Everglade	8	712	670	42	5.89	
3670	R8 – T8	Trinidad	8	512	490	22	4.29	
3670	R8 – T7	Do	8	267	240	27	10.11	
1749	R8 – T8	Lime	11	178	150	26	14.60	2
3669	R9 – T4	Everglade	8	117	107	10	8.54	
1749	R8 – T7	Lime	11	59	50	9	15.25	
5176	R8 – T3	Do	8	30	12	18	60.00	
902	R17–T10	Dayap	11	24	16	5	20.83	3
901	R17– T9	Do	11	23	15	4	17.39	4
5163	R4 – T3	Tahiti	6	18	10	8	44.44	
901	R17– T8	Dayap	11	15	12	3	20.00	
2182	R6 –T13	Lime	10	15	10	5	33.33	
5163	R4 – T4	Tahiti	6	9	5	4	44.44	
5176	R8 – T4	Lime	8	6	3	3	50.00	
		Citrus aurantium:						
1638	R11– T2	Sour orange	11	226	120	7	3.09	99
1338	R11– T1	Do	11	210	95	10	4.76	105
2385	R7 – T3	Do	8	140	86	50	35.71	4
2662	R1 – T3	Do	8	130	90	40	30.76	
2662	R3 – T6	Do	8	104	75	29	27.88	
2385	R7 – T4	Do	8	99	30	20	20.20	49
2662	R3 – T5	Do	8	49	30	19	38.77	
2662	R1 – T2	Do	8	35	15	20	57.14	
2511	R2 – T4	Do	8	18	10	8	44.44	
2511	R2 – T3	Do	8	------	------	------	------	
1264	R6 – T1	Do	7	------	------	------	------	
		Citrus hystrix:						
5165	R5 – T9	Suangui	6	120	28	50	41.66	42
3668	R8 – T3	*Citrus hystrix*	8	86	0	86	100	10
5165	R5 –T10	Suangui	6	66	36	20	30.30	
3656	R9 – T4	Kanci, var. *boholensis*	8	65	0	65	100	
4225	R6 – T4	Kalo-oy	8	51	26	25	49.01	
4824	R8 – T1	Kanci, var. *boholensis*	8	36	0	36	100	
4225	R6 – T3	Kalo-oy	8	30	10	20	66.66	
5137	R11–T12	Kolobot, var. *torosa*	8	25	6	10	40.00	
2049	R6 – T8	*Citrus hystrix*	10	23	0	23	100	
5189	R14– T6	Kabuyau	6	16	13	3	18.75	
2494	R2 – T7	Do	8	15	0	15	100	
4214	R6 – T4	Kamugau	8	14	0	14	100	

TABLE 4.—*Production of bearing citrus trees at Lamao Experiment Station*—Continued.

P. I. No.	Row and tree Nos.	Scientific and common name.	Age.	Actual yield in fruits.		Fruits dropped.		Unaccountable losses.
				On tree.	Harvested.			
		Citrus hystrix:	*Yrs.*			*Number.*	*Per cent.*	
5137	R11–T11	Kolobot, var. *torosa*	8	12	2	5	41.66	5
2049	R6 – T7	*Citrus hystrix*	10	10	0	10	100	
3665	R4 –T12	Kolobot, var. *torosa*	5	8	0	8	100	
3665	R4 –T11	Do	5					
		Citrus maxima:						
4830	R9 – T3	Amontay	8					
2665	R5 – T4	Lukban	10	138	110	8	5.79	20
2687	R6 – T1	Duncan	8	123	86	20	16.26	17
4118	R10– T2	Walter	8	96	55	41	42.70	
1631	R11– T4	Marsh	11	90	25	65	72.22	
3882	R7 –T10	McCarthy	8	88	39	49	55.68	
4121	R10– T8	Do	8	64	41	23	35.93	
1633	R12– T2	Case pomelo	11	63	60	3	4.76	
3673	R12– T1	Siamese	8	60	58	2	3.33	
1632	R13– T5	Triumph	11	59	30	29	49.15	
4125	R11– T6	Royal	8	49	4	45	91.83	
3882	R7 – T9	McCarthy	8	46	2	44	95.65	
2690	R6 – T8	Marsh	7	44	7	37	84.09	
1713	R9 – T1	Triumph	11	42	14	28	66.66	
1632	R13– T6	Do	11	37	17	20	54.05	
1633	R12– T1	Case pomelo	11	28	23	1	3.57	4
4121	R10– T7	McCarthy	8	26	22	4	15.38	
4118	R10– T1	Walter	8	25	3	22	88.00	
1333	R16– T6	Ellen	11	22	5	17	77.27	
1995	R4 – T8	Pomelo	8	13	14	2	11.11	2
3384	R7 – T6	Saigon	8	18	13			5
4868	R11– T4	Kellogg	8	16	14	2	12.5	
2524	R11– T7	Pomelo	8	14	14	0	0	
5102	R11– T5	Lias	5	13	7	6	46.15	
4125	R11– T5	Royal	8	12	0	12	100	
3384	R7 – T5	Saigon	8	12	5			7
5144	R13– T1	Panuban	8	11	3	6	54.54	2
8442	R4 – T5	Siamese	8	11	0	0	0	
1333	R16– T5	Ellen	11	6	0	6	100	
1707	R10– T5	Marsh	11	4	0	4	100	
5152	R12– T3	Siamese	6	3	1	0		2
2687	R6 – T2	Duncan	8	2	0	2	100	
4868	R11– T3	Kellogg	8	2	2	0	0	
893	R17– T4	Pomelo	11	1	0	1	100	
5152	R12– T4	Siamese	6	1	0	1	100	
3391	R14– T4	Yugelar	8	1	1	0	0	
1713	R9 – T2	Triumph	11	0	0	0	0	
1707	R10– T6	Marsh	11	0	0	0	0	
1334	R15– T1	Pernambuco	11	0	0	0	0	
891	R17– T1	Pomelo	11	0	0	0	0	
891	R17– T2	Do	11	0	0	0	0	
899	R17– T7	Do	11	0	0	0	0	

TABLE 4.—*Production of bearing citrus trees at Lamao Experiment Station*—Continued.

P. I. No.	Row and tree Nos.	Scientific and common name.	Age.	Actual yield in fruits.		Fruits dropped.		Unaccountable losses.
				On tree.	Harvested.			
		Citrus maxima:	*Yrs.*			*Number.*	*Per cent.*	
3876	R5 – T7	Nakoin	8	0	0	0	0	
1334	R15– T2	Pernambuco	7	0	0	0	0	
5181	R3 –T11	Pomelo	7	0	0	0	0	
5181	R3 –T12	Do	7					
2700	R4 – T5	McCarthy	8					
1995	R4 – T4	Pomelo	8					
3389	R9 – T1	Siamese	8					
5523	R15–T12	Pomelo	6					
3392	R14– T2	Yugelar	8					
2503	R1 – T4	Boongon	8					
		Citrus mitis:						
2513	R13– T1	Kalamondin	8	2,710	2,585	125	4.61	
	R13– T9	Do	8	1,300	1,094	206	15.84	
2355	R1 – T9	Do	8	650	530	120	18.46	
2332	R15– T1	Do	8	556	495	61	10.97	
2513	R13– T2	Do	8	275	245	30	10.90	
2332	R15– T2	Do	8	70	53	17	24.28	
	R13–T10	Do	8	70	50	20	28.57	
		Citrus nobilis:						
1271	R7 – T4	Kishiu	11	100	35	45	45	20
3383	R7 – T2	*Citrus nobilis*	8	89	15	35	39.32	39
5173	R6 – T9	Saagkam	6	65	5	60	92.30	
745	R13– T4	Tizon, var. *papillaris*	5	28	8	20	71.42	
2693	R3 –T10	King	8	25	15	4	16.00	6
1335	R14– T2	Oneco	11	18	2	16	88.88	
1265	R2 – T2	China	11	16	2	5	81.25	9
2693	R3 – T9	King	8	3	0	3	100	
744	R20– T3	Tizon, var. *papillaris*	11	1				
744	R12– T9	Molana	8					
745	R20– T4	Tizon, var. *papillaris*	9					
1335	R5 – T3	Oneco	7					
1335	R15– T4	Do	7					
3883	R7 – T9	Do	6					
1335	R14– T1	Do	11					
5173	R6 –T10	Saagkam	6					
1272	R7 – T5	Konda narum	11					
1272	R7 – T6	Do	7					
		Citrus sinensis:						
2695	R5 –T10	Brown	8	517	130	329	63.63	58
1270	R7 – T1	St. Michael	11	400	210	190	47.5	
2568	R5 – T4	Misamis	8	330	110	220	66.66	
2695	R5 – T9	Brown	8	310	82	228	73.54	
1270	R7 – T2	St. Michael	11	290	120	170	58.62	
3660	R8 – T6	Balanga	8	281	82	35	12.45	164
1259	R12– T7	Malta blood	8	198	147	51	25.75	
4126	R2 – T4	Foster	8	183	30	153	83.6	

TABLE 4.—*Production of bearing citrus trees at Lamao Experiment Station*—Continued.

P. I. No.	Row and tree Nos.	Scientific and common name.	Age.	Actual yield in fruits.		Fruits dropped.		Unaccountable losses.
				On tree.	Harvested.			
		Citrus sinensis:	*Yrs.*			*Number.*	*Per cent.*	
3660	R8 – T5	Balanga	8	169	66	30	17.75	73
4119	R10– T4	Dugat	8	163	32	100	61.34	131
4126	R2 – T3	Foster	8	160	16	144	90.00	
4124	R11– T4	Carleton	8	158	78	80	50.63	
1635	R12– T5	Pineapple	11	150	116	34	22.66	
56	R8 – T9	Jaffa	11	135	23	112	82.96	
2686	R3 – T7	Pineapple	8	129	104	10	7.75	15
4123	R11– T1	Magnum bonum	8	110	90	20	18.18	
1706	R10– T3	Valencia	11	98	20	78	79.59	
5177	R12– T5	Pongkan	6	95	71	24	25.26	
1705	R10– T2	Mediterranean	11	93	59	34	36.55	
4124	R11– T3	Carleton	8	80	62	18	22.50	
2694	R4 – T1	Majorca	8	78	63	15	19.23	
1714	R9 – T3	Larrantta	11	70	16	54	77.14	
1639	R11– T4	Ruby	11	69	60	9	13.04	
1705	R10– T1	Mediterranean	9	60	17	43	71.66	
1639	R11– T3	Ruby	11	60	46	14	23.33	
2698	R13– T5	Boone	8	58	30	28	48.27	
4117	R9 – T9	Brown	8	53	39	14	26.41	
1266	R3 – T8	Whitaker	8	53	11	42	79.24	
4119	R10– T3	Dugat	8	50	25	25	50.00	
1258	R2 – T1	Jaffa	8	50	17	33	66.00	
4123	R11– T2	Magnum bonum	8	49	32	17	34.69	
1715	R9 – T5	White siletta	11	44	18	26	59.09	
1701	R11– T7	Holdfast	11	43	10	33	76.74	
1636	R12– T7	Washington navel	11	43	14	29	67.44	
1728	R8 – T5	Orange	11	34	15	19	55.88	
2697	R4 – T3	Maltese blood	8	31	2	29	93.54	
5177	R12– T6	Pongkan	6	28	13	15	53.57	
1266	R3 – T7	Whitaker	8	27	5	22	81.48	
1719	R9 –T11	Jaffa	11	27	5	22	81.48	
1706	R10– T4	Valencia	11	26	4	22	84.61	
1260	R3 – T6	Excelsior	11	25	8	7	28.00	10
2697	R4 – T4	Maltese blood	8	23	1	22	95.65	
1715	R9 – T6	White siletta	11	19	2	17	89.47	
4117	R9 –T10	Brown	8	18	2	16	88.88	
2689	R6 – T5	Enterprise	8	18	8	10	55.55	
3886	R7 – T7	Du Roi	8	17	5	12	70.58	
1258	R2 – T2	Jaffa	8	16	2	14	87.5	
1701	R11– T8	Holdfast	11	15	2	13	86.66	
966	R16– T3	Cajel	11	14	5	9	64.28	
51	R20– T1	Valencia	11	13	6	4	30.76	
1637	R12– T9	Jaffa	11	12	7	5	41.66	
966	R16– T4	Cajel	11	8	2	6	75.00	
1728	R8 – T6	Orange	11	7	2	5	71.42	
1720	R9 –T13	Bahia	11	7	2	5	71.42	
51	R20– T2	Valencia	11	6	4	2	33.33	

TABLE 4.—*Production of bearing citrus trees at Lamao Experiment Station*—Continued.

P. I. No.	Row and tree Nos.	Scientific and common name.	Age.	Actual yield in fruits.		Fruits dropped.		Unaccountable losses.
				On tree.	Harvested.			
		Citrus sinensis:	*Yrs.*			*Number.*	*Per cent.*	
2365	R5 – T9	Orange	10	5	1	4	80.00	
1719	R9 –T12	Jaffa	11	5	2	3	60.00	
1277	R2 – T3	Seville	11	4	0	4	100	
1637	R12–T10	Jaffa	11	4	0	4	100	
51	R9 – T1	Valencia	6	4	2	------	------	2
2568	R2 – T5	Orange	8	3	0	3	100	
2426	R1 –T11	*Citrus sinensis*	8	------	------	------	------	
2569	R2 – T7	Valencia	8	------	------	------	------	
1711	R10–T12	Washington navel	8	------	------	------	------	
		Citrus webberi:						
2266	R5 – T5	Kabugau, *Citrus webberi* var. *montana.*	10	460	300	100	34.7	60
5105	R11– T9	Alsem	8	56	0	20	35.71	36
5102	R11– T6	*Citrus webberi*	5	29	17	10	34.48	2
896	R17– T5	Kabugau, *Citrus webberi* var. *montana.*	11	28	20	8	28.57	
5102	R11– T5	*Citrus webberi*	5	13	7	6	46.15	
896	R17– T6	Do	11	12	8	4	33.33	
853	R18– T5	Alsem	10	4	0	4	100	
853	R18– T6	Do	19	------	------	------	------	
		Citrus excelsa:						
3388	R7 –T11	Le Nestour	8	23	5	18	78.26	
3841	R5 – T2	Tanchau	8	16	0	16	100	

Under *Citrus aurantifolia* Swingle, 3669 Everglade showed the largest yield, 712 fruits; 3670 R8–T8 Trinidad was second, with 512 fruits; and 3670 R8–T7 Trinidad third, with 267 fruits; 5163 Tahiti yielded only 9 fruits, and 5176 Lime, only 6 fruits.

Under *Citrus aurantium* Linnæus 1638 R11–T2 Sour orange showed the largest yield, 226 fruits; 1338 R11–T1 Sour orange was second, with 210 fruits; and 2385 Sour orange third, with 140 fruits; 2511 and 1264 did not bear any fruit at all.

Under *Citrus excelsa* Wester, 3388 Le Nestour gave 23 fruits and 3841 Tanchau gave 16 fruits.

Under *Citrus hystrix* de Candolle 5165 R5–T9 Suangui showed the largest yield, 120 fruits; 3668 was second, with 86 fruits; and 5165 Suangui third, with 66 fruits. No. 3655 Kolobot produced only 8 fruits; 3665 R4–T11 Kolobot, and 4830 Amontay did not produce any fruit at all.

Under *Citrus maxima*, 2665 Lukban showed the largest yield, with 138 fruits; 2687 Duncan was second, with 123 fruits; and 4118 Walter third, with 96 fruits. No. 893 Pomelo, 5152 Siamese, and 3391 Yugelar produced only one fruit each, and the following did not produce any fruit at all:

1713. Triumph.
1707. Marsh.
1334. Pernambuco.
891. Pomelo.
899. Pomelo.
3876. Nakoin.
5181. Pomelo.
2700. McCarthy.
1995. Pomelo.
3389. Siamese.
5523. Pomelo.
3392. Yugelar.
2503. Boongon.

Under *Citrus mitis* Blanco, 2513 Kalamondin showed the largest yield, 2,710 fruits; R13–T9 Kalamondin was second, with 1,300 fruits; and 2355 Kalamondin third, with 650 fruits. No. 2332 Kalamondin and R13–T10 Kalamondin gave 70 fruits each. All of the trees bearing produced fruits throughout the year.

Under *Citrus nobilis* Loureiro, 1271 Kishiu showed the largest yield, 100 fruits; 3383 was second, with 89 fruits; and 5173 Saagkam third, with 65 fruits. No. 744 R20–T3 Tizon gave only 1 fruit, while the following were non-bearers:

744. R12-T9 Molana.
745. Tizon.
1335. R5-T3 Oneco.
3883. Oneco.
5173. Saagkam.
1272. Konda narum.

Under *Citrus sinensis* Osbeck, 2695 Brown showed the largest yield, 517 fruits; 1270 St. Michael was second, with 400 fruits; and 2568 Misamis third, with 330 fruits. The following produced between 3 and 8 fruits:

966. Cajel.
1728. Orange.
1720. Bahia.
51. Valencia.
2365. Orange.
1719. Jaffa.
1277. Seville.
1637. Jaffa.
2568. Orange.

No. 2426, 2569 Valencia, and 1711 Washington navel produced no fruits.

Under *Citrus webberi* Wester, 2266 Kabugao showed the largest yield, 460 fruits; 5105 Alsem was second, with 56 fruits; and 5102 third, with 29 fruits; 853 R18–T5 Alsem produced only 4 fruits, and 853 R18–T6 yielded none.

The following trees produced fruits out of season:

Everglade lime.	1635. Pineapple orange.
Trinidad lime.	1639. Ruby orange.
5176. Lime.	4119. Dugat orange.
3660. Balanga orange.	2695. Brown orange.
2568. Misamis orange.	1260. Excelsior orange.
2686. Pineapple orange.	2689. Enterprise orange.

That the Philippine Islands is very well adapted to citriculture is indicated by the fact that there are at least a few kinds of citrus trees grown in every province excepting Cotabato.

Table 5 shows the distribution and production of citrus trees by provinces for the years ending June 30, 1921, 1922, and 1923. Mandarins, oranges, and pomelos are the only kinds of citrus considered, as these are the commonest commercially.

From Table 5 it will be seen that Batangas Province ranks first in the number of mandarin trees cultivated during 1923, with 225,900 trees cultivated, but only 123,900 bearing; Ilocos Norte is second, with 30,400 trees cultivated and 22,300 bearing; and Cebu is third, with 17,400 trees cultivated and 10,000 bearing. Although Batangas Province leads in the number of mandarin trees cultivated, yet its fruit production may be considered as poor when compared with that of other provinces. In 1923 Romblon produced 411,200 mandarins from 2,000 trees, or an average of 205 fruits per tree; Batangas had a fruit production of 11,960,000 from 123,900 trees, or an average of about 96 fruits per tree, less than half of the average fruit production per tree of Romblon. Albay comes next to Romblon in fruit production, 837,700 fruits from 4,400 trees, or about 190 fruits per tree. Pangasinan ranks third, with a production of 1,000,500 fruits from 5,400 trees, or an average of about 185 fruits per tree. Batanes had the lowest fruit production, 3,000 fruits from 100 trees, or an average of 30 mandarins per tree. It will also be noticed that Agusan, Cotabato, Lanao, and Masbate do not grow mandarins. Possibly these places are not well adapted for mandarin cultivation, or perhaps no attention has been paid to mandarin growing there.

Table 5 also shows that Batangas ranks first in the number of orange trees cultivated for the year 1923, namely, 24,470. Iloilo comes next, with 18,730 orange trees, and Pangasinan third, with 17,700 trees. Iloilo ranks first in bearing trees,

13,440; Batangas second, with 13,010; and Albay third, with 12,320. Cotabato is the only province that does not cultivate oranges. It is probable that this place is not at all adapted to citriculture, since no form of citrus is being grown there, judging from the table on citrus distribution given. Rizal in 1923 produced 239,200 oranges from 1,350 trees, or an average of 177 fruits per tree. Masbate produced from 140 trees 22,600 oranges, or an average of 161 oranges per tree. Tarlac ranks third, with 364,600 oranges from 2,290 trees, or an average of 159 oranges per tree. The Batangas production was 840,900 oranges from 13,010 trees, or an average of 64 oranges per tree, which amounted to about one-third of the average fruit production per tree of Rizal. Leyte gave the smallest average production, 38 oranges per tree.

Pomelos are produced to the greatest extent in Camarines Sur. Table 5 shows that province to have cultivated 34,350 trees; Albay is second, with 24,540 trees; and Oriental Negros third, with 22,640 trees. In the number of pomelo trees bearing for the year 1923, Camarines Sur leads the other provinces with 27,380 trees; Albay is second, with 14,350 trees; and Nueva Ecija third, with 12,670 trees. Agusan, Batanes, Bukidnon, Cotabato, Palawan, and Zamboanga Provinces do not cultivate pomelos to any great extent. In fruit production per tree Occidental Negros ranked first, with 1,100,200 pomelos from 6,720 bearing trees, or an average of 163 per tree; Oriental Negros ranked second, with 1,685,300 pomelos from 12,400 trees, or an average of 135 per tree; Albay was third, with 1,908,700 pomelos from 14,350 trees, or an average of 133 per tree. Tayabas had the lowest average production, about 28 pomelos per tree. Batangas produced 144,400 pomelos from 2,720 trees, or an average of about 53 fruits per tree, less than one-third of the average fruit production per tree of Occidental Negros.

According to the totals given in Table 5 it will be seen that the total number of citrus trees cultivated in the years 1921 to 1923 is 890,970; of bearing trees, 560,700; and of fruit production, 49,735,600.

The average cultivated area per tree is estimated to be 44 square meters. Therefore, the Philippine Islands has an estimated area under commercial citrus cultivation of about 3,920 hectares. It must not be forgotten that thousands of trees of other kinds of citrus are also grown throughout the Islands, although not to any extent commercially.

TABLE 5.—*Number of trees planted, trees bearing and the production, by provinces, for the years ending June 30, 1921, 1922, and 1923.*

MANDARIN.

Province.	Trees cultivated.			Trees bearing.			Production (fruits).			Average number of fruits produced per tree in 1923.
	1921	1922	1923	1921	1922	1923	1921	1922	1923	
Abra	200	300	300	200	100	100	21,700	8,800	11,000	110
Agusan										
Albay	7,300	7,400	7,500	4,100	4,200	4,400	828,000	809,000	837,700	190.4
Antique	200	200	200	100	100	100	5,000	6,400	6,600	66
Bataan	200	300	300	100	100	100	1,400	3,100	4,300	43
Batanes	300	300	300	100	100	100	2,100	2,400	3,000	30
Batangas	220,700	223,000	225,900	124,400	125,200	123,900	12,101,000	11,819,000	11,960,000	96.4
Bohol	2,900	2,500	2,500	1,500	1,400	1,400	119,200	96,700	104,800	74.8
Bukidnon	5,000	5,200	5,300	3,200	3,400	3,400	121,800	136,000	132,600	39
Bulacan	1,900	1,500	1,500	1,400	900	900	82,000	47,000	51,800	57.5
Cagayan	6,100	6,500	6,700	4,100	4,300	4,400	413,300	414,800	449,300	102.1
Camarines Norte	300	500	500	300	200	200	31,700	12,400	12,600	63
Camarines Sur	4,500	4,600	4,800	3,400	3,500	3,600	256,600	265,200	254,300	70.6
Capiz	200	200	300	100	100	100	5,800	9,900	8,600	86
Cavite	2,900	2,900	3,000	2,400	2,500	2,500	145,000	147,000	156,000	62.4
Cebu	17,100	17,400	17,400	9,700	9,800	10,000	985,600	1,011,000	1,040,900	104
Cotabato										
Davao		100	100							
Ilocos Norte	29,500	30,100	30,400	21,800	21,900	22,300	1,962,200	1,968,900	2,013,100	90.2
Ilocos Sur	2,800	2,900	3,000	1,300	1,100	1,400	139,000	117,700	95,700	68.4
Iloilo	3,400	3,500	3,700	1,600	1,600	1,800	154,700	162,400	193,800	107.6
Isabela	1,800	1,800	1,700	1,400	1,600	1,500	74,600	57,900	55,400	37.0
Laguna	4,700	4,800	5,200	2,700	2,700	2,900	439,000	444,500	495,400	170.8

TABLE 5.—*Number of trees planted, trees bearing and the production, by provinces, for the years ending June 30, 1921, 1922, and 1923*—Continued.

MANDARIN—Continued.

Provinces.	Trees cultivated.			Trees bearing.			Production (fruits).			Average number of fruits produced per tree in 1923.
	1921	1922	1923	1921	1922	1923	1921	1922	1923	
Lanao										
La Union	800	800	900	400	400	500	101,700	47,300	54,500	109
Leyte	9,200	9,400	9,400	6,300	6,400	6,600	755,200	805,100	875,800	132
Marinduque	2,100	2,000	2,000	900	900	1,000	16,600	29,100	35,000	35
Masbate										
Mindoro	1,900	2,600	2,900	1,600	1,900	2,000	123,600	138,200	185,000	92
Misamis	2,100	2,100	2,100	1,600	1,600	1,600	213,800	215,600	215,600	134
Mountain	1,600	1,500	1,600	1,200	1,100	1,100	157,700	168,000	165,500	150
Nueva Ecija	400	400	500	300	300	300	37,600	39,500	55,400	184
Nueva Vizcaya	400	500	700	100	100	200	4,800	7,500	33,600	168
Occidental Negros	4,800	4,900	4,900	4,000	3,200	3,200	221,100	225,100	210,100	65
Oriental Negros	1,200	1,200	1,200	900	1,000	1,000	102,000	109,700	117,700	117
Palawan	2,000	2,100	2,300	1,100	1,100	1,300	105,000	122,600	146,000	112
Pampanga	600	600	600	300	300	300	21,000	21,000	24,000	80
Pangasinan	10,500	10,600	10,700	5,300	5,400	5,400	937,700	863,400	1,000,500	185
Rizal	1,100	1,200	1,400	100	200	200	7,100	20,000	15,500	77
Romblon	3,200	3,200	3,200	2,000	2,000	2,000	380,000	413,200	411,200	205
Samar	1,700	1,800	1,900	700	700	700	71,800	48,300	62,100	88
Sorsogon	1,300	1,200	1,300	1,000	1,000	1,000	49,100	48,300	49,100	49
Sulu	700	700	700	500	500	500	80,000	80,000	85,000	170
Surigao	200	300	300	100	100	100	4,200	10,100	6,600	66
Tarlac	300	400	400	300	200	300	29,900	32,000	21,000	70
Tayabas	10,600	10,700	10,300	6,200	6,200	6,300	1,061,700	1,011,900	1,012,700	160

Zambales	1,000	1,100	1,300	600	600	700	87,800	79,300	86,100	123
Zamboanga		100	100							
Total	869,700	375,400	381,300	219,400	220,000	221,400	22,459,100	22,075,300	22,754,900	

ORANGE.

Abra	3,780	4,000	4,230	2,860	2,510	2,570	166,700	186,100	193,800	75
Agusan	860	860	900	670	670	670	40,000	39,300	41,000	61
Albay	16,490	16,730	17,010	11,880	12,030	12,320	993,300	921,100	1,063,800	86
Antique	230	280	300	100	100	110	8,400	9,900	10,800	98
Bataan	350	370	480	80	100	100	2,700	4,000	4,500	45
Batanes	200	200	200	100	100	100	5,000	5,000	5,000	50
Batangas	23,530	24,080	24,470	12,400	12,920	13,010	758,200	723,300	840,900	64
Bohol	5,590	5,810	5,920	3,690	3,830	3,930	203,000	172,200	233,700	59
Bukidnon	200	200	200	200	200	200	9,000	10,000	9,500	47
Bulacan	590	640	650	250	270	270	10,000	12,700	13,600	50
Cagayan	12,060	12,360	12,560	9,040	9,220	9,390	671,400	698,400	723,400	77
Camarines Norte	470	490	500	270	290	310	17,500	18,500	22,800	73
Camarines Sur	5,910	5,990	6,110	3,610	3,760	3,840	217,900	203,900	255,800	66
Capiz	2,080	2,170	2,210	1,430	1,470	1,470	149,300	159,500	160,400	109
Cavite	2,040	2,040	2,270	1,820	1,880	1,950	203,400	237,600	206,900	106
Cebu	12,850	13,260	13,750	9,620	9,750	10,070	751,500	808,000	839,800	83
Cotabato										
Davao	730	750	800	300	300	300	29,600	29,100	38,800	129
Ilocos Norte	13,420	13,910	14,370	9,370	9,760	9,840	1,016,000	1,090,800	954,800	97
Ilocos Sur	5,480	5,750	5,950	3,530	3,690	3,920	442,100	470,000	553,300	141
Iloilo	17,700	18,410	18,730	12,200	13,270	13,440	913,700	1,040,300	1,098,200	81
Isabela	7,190	7,270	7,480	6,820	6,840	6,850	375,200	382,600	388,700	56
Laguna	2,420	2,560	2,610	1,790	1,790	1,830	107,200	125,500	134,500	73
Lanao	1,780	1,830	1,850	1,410	1,440	1,460	79,200	91,700	93,800	64
La Union	4,220	4,210	4,300	2,070	2,120	2,140	189,900	213,100	221,700	103
Leyte	7,780	7,980	8,010	6,500	6,710	6,770	197,100	229,300	263,700	38
Marinduque	4,740	4,770	5,000	2,270	2,270	2,270	113,900	122,900	124,100	54

TABLE 5.—*Number of trees planted, trees bearing and the production, by provinces, for the years ending June 30, 1921, 1922, and 1923*—Continued.

ORANGE—Continued.

Province.	Trees cultivated.			Trees bearing.			Production (fruits).			Average number of fruits produced per tree in 1923.
	1921	1922	1923	1921	1922	1923	1921	1922	1923	
Masbate	300	300	300	130	140	140	13,900	14,800	22,600	161
Mindoro	1,320	1,360	1,420	750	780	780	46,300	55,200	59,200	75
Misamis	8,390	8,410	8,770	5,030	5,620	5,020	203,400	220,700	256,200	51
Mountain	3,400	3,500	3,670	2,500	2,540	2,540	138,900	144,300	157,600	62
Nueva Ecija	4,190	4,670	4,740	3,100	3,120	3,120	255,200	257,300	293,400	94
Nueva Vizcaya	810	900	1,000	460	470	470	47,500	55,000	53,700	114
Occidental Negros	11,380	11,400	11,540	10,060	10,070	10,070	677,500	761,200	778,600	77
Oriental Negros	3,210	3,240	2,680	1,480	1,550	1,550	144,900	156,900	181,400	117
Palawan	2,040	2,120	2,190	1,450	1,490	1,490	121,200	121,200	132,100	88
Pampanga	800	800	800	800	800	800	93,000	94,000	96,000	120
Pangasinan	17,000	17,390	17,770	9,050	9,250	9,250	787,200	835,700	893,200	96
Rizal	2,260	2,320	2,370	1,340	1,350	1,350	189,400	232,500	239,200	177
Romblon	870	920	930	640	650	650	46,800	49,400	52,300	80
Samar	4,240	4,480	4,590	3,110	3,100	3,100	131,600	136,500	158,900	51
Sorsogon	1,640	1,650	1,660	1,040	1,040	1,040	114,400	119,400	106,900	102
Sulu	200	200	200	200	200	200	10,000	8,000	10,000	50
Surigao	3,680	3,710	3,730	800	820	820	55,100	56,800	62,900	76
Tarlac	3,530	3,660	3,750	2,260	2,290	2,290	342,400	362,600	364,600	159
Tayabas	7,660	7,750	7,850	3,990	4,020	4,020	320,300	332,100	349,600	86
Zambales	1,280	1,360	1,500	630	640	640	57,800	59,800	65,400	102
Zamboanga	300	300	300							
Total	231,190	237,360	242,620	152,600	156,630	158,470	11,468,000	12,078,200	12,831,100	

POMELO.

Abra	270	280	290	40	60	60	2,000	2,700	2,700	45
Agusan										
Albay	23,970	24,220	24,540	13,620	14,150	14,350	1,639,900	1,772,700	1,908,700	133
Antique	1,550	1,560	1,600	970	960	1,000	38,900	38,400	50,000	50
Bataan	2,890	3,020	3,100	1,040	1,070	1,160	78,900	80,700	94,900	81
Batanes										
Batangas	3,450	3,570	3,790	2,580	2,610	2,720	114,100	118,700	144,400	53
Bohol	1,630	1,650	1,690	590	590	590	12,000	12,200	17,900	30
Bukidnon										
Bulacan	4,510	4,630	4,840	2,900	2,970	3,080	78,800	92,300	115,600	37
Cagayan	5,700	5,730	5,840	3,900	3,940	4,040	97,100	100,800	134,500	33
Camarines Norte	560	590	600	440	450	450	26,900	26,500	28,000	62
Camarines Sur	33,860	34,090	34,350	27,060	27,300	27,380	2,515,100	2,661,500	3,002,600	109
Capiz	1,940	2,000	2,070	1,510	1,550	1,610	66,400	59,100	75,100	46
Cavite	1,270	1,280	1,340	1,060	1,070	1,110	25,100	26,900	37,500	33
Cebu	10,640	11,100	11,370	7,310	7,440	7,540	418,200	434,300	465,200	61
Cotabato										
Davao	490	490	500	390	400	400	7,800	9,000	12,000	30
Ilocos Norte	3,320	3,380	3,440	1,990	2,020	2,050	39,800	52,000	60,390	29
Ilocos Sur	8,380	8,490	8,610	5,350	5,390	5,480	218,000	218,700	260,700	47
Iloilo	15,470	15,580	15,730	11,700	11,880	12,390	534,100	591,600	796,800	64
Isabela	270	270	310							
Laguna	3,230	3,250	3,330	1,950	2,000	2,050	55,200	72,300	92,200	45
Lanao	350	350	350							
La Union	4,100	4,190	4,250	2,270	2,330	2,370	88,400	93,700	116,500	49
Leyte	3,230	3,380	3,380	2,630	2,630	2,730	86,600	96,000	116,000	42
Marinduque	3,540	3,700	3,740	2,980	3,030	3,070	89,400	100,900	132,900	43
Masbate	1,100	1,100	1,110	400	400	400	12,000	16,000	20,000	60
Mindoro	3,520	3,530	3,590	2,850	2,850	2,850	135,100	155,000	183,200	64
Misamis	1,000	1,020	1,050	150	150	150	3,000	5,000	4,500	30
Mountain	510	540	560	330	350	350	22,700	27,100	27,500	78

TABLE 5.—*Number of trees planted, trees bearing and the production, by provinces, for the years ending June 30, 1921, 1922, and 1923*—Continued.

POMELO—Continued.

Province.	Trees cultivated.			Trees bearing.			Production (fruits).			Average number of fruits produced per tree in 1923.
	1921	1922	1923	1921	1922	1923	1921	1922	1923	
Nueva Ecija	14,180	14,200	14,290	12,610	12,650	12,670	651,700	751,300	870,300	68
Nueva Vizcaya	620	630	650	330	340	350	14,500	12,100	13,300	38
Occidental Negros	7,610	7,660	7,950	6,460	6,540	6,720	600,900	943,100	1,100,200	163
Oriental Negros	22,160	22,390	22,640	12,270	12,350	12,400	1,554,400	1,551,200	1,685,300	135
Palawan										
Pampanga	5,500	5,540	5,550	4,490	4,490	4,640	191,500	163,400	231,600	49
Pangasinan	17,340	17,530	18,030	10,010	10,280	10,440	412,700	442,100	470,200	45
Rizal	4,830	4,820	4,940	2,710	2,720	2,790	140,000	137,500	171,200	61
Romblon	3,370	3,840	3,910	3,030	3,110	3,100	213,300	232,800	255,000	82
Samar	8,400	8,530	8,770	7,250	7,400	7,580	243,000	248,700	290,500	38
Sorsogon	12,240	12,220	12,350	9,920	9,780	9,860	652,300	777,700	766,100	77
Sulu	1,100	1,100	1,100	870	870	870	29,400	30,100	30,100	34
Surigao	500	500	500	400	300	300	20,000	15,000	15,000	50
Tarlac	2,490	2,540	2,570	1,140	1,180	1,200	35,600	37,000	67,800	56
Tayabas	16,390	16,490	16,610	7,420	7,520	7,570	235,700	240,600	216,300	28
Zambales	1,880	1,920	1,920	840	880	960	49,400	56,100	67,000	69
Zamboanga										
Total	259,360	262,900	267,050	175,760	178,000	180,830	11,449,900	12,502,800	14,149,600	

Of the citrus-producing provinces in the Philippine Islands, Batangas alone supplies the Manila markets with mandarins and oranges. The production of the other provinces is consumed locally. To give those interested an idea as to the tonnage of oranges [3] annually shipped to Manila from Batangas, the data obtained from the Manila Railroad Company are here presented as Table 6.

TABLE 6.—*Citrus fruits shipped annually from Batangas Province to Manila, 1910 to 1923.*

Year.	Tons.	Fruits (calculated).	Estimated value.	Year.	Tons.	Fruits (calculated).	Estimated value.
			Pesos.				*Pesos.*
1910	8,000	58,000,000	1,160,000.00	1917	2,853	20,493,099	409,861.98
1911	427	3,000,000	60,000.00	1918	1,968	14,136,144	282,722.88
1912	2,657	19,085,231	381,704.62	1919	3,549	25,492,467	509,849.34
1913	4,816	34,593,328	691,866.56	1920	2,638	18,948,754	378,975.08
1914	2,510	18,029,330	360,586.60	1921	776	5,574,008	111,480.16
1915	2,040	14,653,320	293,066.40	1922	1,705	12,247,015	244,940.30
1916	1,979	14,215,157	284,303.14	1923	2,110	15,156,130	303,122.60

These figures represent shipments by freight only; they do not include shipments by truck and express.

The 41 kinds of citrus that we have studied and the 5 studied by Gibbs and Agcaoili [4] constitute only a small part of the whole for, as has already been mentioned, there are about 800 types of citrus growing in the Philippines, including the valid Philippine species, the hybrids, and the introduced species.

CHEMICAL ANALYSIS

Table 7 gives the common names of the 41 kinds of citrus fruits that were analyzed, their botanical names, the soil in which grown, description of the fruits, and whether common or rare forms. It will be noticed that most of the fruits are of the introduced species under experimentation at Lamao Experiment Station.

[3] Including mandarins, oranges, and a few pomelos.

[4] Philip. Journ. Sci. § A 7 (1912) 403.

TABLE 7.—*List of citrus fruits analyzed; all from Lamao Experiment Station.*

P. I. No.	Variety name.	Scientific name.	Soil.	Description of fruit.	Common or rare.	Native or foreign.
3660	Balanga orange	*Citrus sinensis* Osbeck	Loam	Fruits round; rind rather smooth, medium fairly loose; flesh light yellow; quality good; fairly juicy and sweet.	Rare	Native.
2698	Boone orange	do.	Sandy clay loam	Fruits round; flesh light yellow; rind fairly smooth; juicy and subacid.	do.	Foreign.
2695	Brown orange	do.	do.	Fruits oval; flesh light yellow; rind smooth and fairly loose; quality fairly good; fairly juicy and subacid.	do.	Do.
4124	Carleton orange	do.	do.	Fruits oblong; flesh light yellow; rind fairly loose and smooth; quality fair; fairly juicy and sweet.	do.	Do.
4119	Dugat orange	do.	do.	Fruits round; flesh yellow; rind smooth and fairly loose; quality fairly good; fairly juicy and sweet.	do.	Do.
2340	Igorot orange	*Citrus* sp.	Loam	Fruits oval; flesh yellowish green; rind rough and fairly loose; quality fairly good; fairly juicy and subacid.	do.	Native.
1637	Jaffa orange	*Citrus sinensis* Osbeck	Sandy clay loam	Fruits round; flesh light yellow; rind smooth and fairly loose; quality good; fairly juicy and sweet.	do.	Foreign.
1714	Larrantta orange	do.	Loam	Fruits round; flesh light yellow; rind smooth and fairly loose; fairly juicy and subacid.	do.	Do.
------	Majorca orange	do.	Sandy clay loam	Fruits round; flesh light yellow; rind rather rough; quality fairly good; juicy and sweet.	do.	Do.
1259	Malta blood orange	do.	do.	Fruits oblong; flesh light yellow; rind rather rough and fairly loose; quality good; fairly juicy and sweet.	do.	Do.

4123	Magnum bonum orange	do	do	Fruits round; flesh light yellow; rind smooth and fairly loose; quality good; fairly juicy and sweet.	do	Do.
2568	Misamis orange	do	do	Fruits oval; flesh light yellow; rind smooth and fairly loose; quality and flavor good; fairly juicy and sweet.	do	Native.
1635	Pineapple orange	do	do	Fruits round; flesh yellow; rind smooth and fairly loose; quality and flavor good; fairly juicy and sweet.	do	Foreign.
2686	Do	do	do	Fruits round; flesh light yellow; rind smooth and fairly loose; quality good; fairly juicy and sweet.	do	Do.
5177	Pongkan orange	do	do	Fruits round; rind rather smooth and thin; flesh light yellow; juicy and subacid.	do	Do.
1618	Sampson orange	*Citrus* hybrid	do	Fruits somewhat round; flesh light yellow; rind smooth and loose; quality poor; rather juicy and sweet.	do	Do.
1638	Sour orange	*Citrus aurantium* Linnæus	do	Fruits oblong; rind rather rough and thick; flesh very light yellow; rather juicy and acid.	do	Do.
1706	Valencia orange	*Citrus sinensis* Osbeck	do	Fruits round; flesh light yellow; rind smooth and fairly loose; quality fairly good; fairly juicy and subacid.	do	Do.
1715	White siletta orange	do	do	Fruits round; flesh light yellow; rind smooth, medium and fairly loose; quality fairly good; not very juicy but sweet.	do	Do.
1266	Whitaker orange	do	do	Fruits round; flesh light yellow; rind smooth and rather loose; quality very good; very juicy and sweet.	do	Do.
2687	Duncan grapefruit	*Citrus maxima* Merrill	do	Fruits oval; flesh white; rind smooth and fairly loose; quality fairly good; juicy and subacid.	do	Do.
1313	Ellen grapefruit	do	do	Fruits oval; flesh white; rind rough; quality fairly good; juicy and subacid.	do	Do.

TABLE 7.—*List of citrus fruits analyzed; all from Lamao Experiment Station*—Continued.

P. I. No.	Variety name.	Scientific name.	Soil.	Description of fruit.	Common or rare.	Native or foreign.
1631	Marsh grapefruit	*Citrus maxima* Merrill	Sandy clay loam	Fruits somewhat round; flesh light yellow; rind rather smooth and thick; not juicy but sweet.	Rare	Foreign.
4121	McCarthy grapefruit	do.	do.	Fruits oblong; flesh light yellow; rind rather rough and fairly loose; quality fairly good; fairly juicy and sweet.	do.	Do.
1334	Pernambuco grapefruit	do.	Loam	Fruits slightly oval; rind smooth, medium and fairly loose; quality fair; fairly juicy and subacid.	do.	Do.
1632	Triumph grapefruit	do.	Sandy clay loam	Fruits almost round; flesh light yellow; rind smooth; flavor and quality good; not very juicy but sweet.	do.	Do.
4118	Walter grapefruit	do.	do.	Fruits oval; flesh white; rind smooth and fairly loose; quality fairly good; juicy and subacid.	do.	Do.
1333	Ellen pomelo	do.	do.	Fruits oval; flesh white; rind rough and fairly loose; quality good; juicy and subacid.	do.	Do.
1635	Pink pomelo	do.	do.	Fruits oval; flesh light pink; rind rough and fairly loose; quality good; somewhat dry but sweet.	do.	Do.
3669	Everglade lime	*Citrus aurantifolia* Swingle	do.	Fruits small and oval; flesh greenish white; rind smooth and thin; rather juicy and very acid.	do.	Do.
5163	Tahiti lime	do.	Loam	Fruits oblong and slightly elongated at two ends; flesh pale green; rind rough, thick, and firm; quality good; fairly juicy and very acid.	do.	Do.
3670	Trinidad lime	do.	Sandy clay loam	Fruits flattened; flesh yellowish green; rind smooth, tight; quality good; fairly juicy and very acid.	do.	Do.

5175	Lemon	*Citrus limonia* Osbeck	do	Fruits small and oval; rind rather smooth; not juicy and very acid.	do	Do.
2502	Biasong	*Citrus micrantha* Wester	do	Fruits oval; flesh light green; rind rough and tight; fairly juicy and very acid; quality poor.	do	Native.
5497	Gauid	*Citrus webberi* var. *montana* Wester	do	Fruits flattened; flesh light green; rind rough and fairly loose; quality fairly good; fairly juicy and very acid.	Common	Do.
5658	Camisan	*Citrus* sp	Loam	Fruits round; flesh light yellow; rind smooth and fairly loose; quality fairly good; fairly juicy and subacid.	Rare	Do.
4827	Lombog	*Citrus pseudolimonum* Wester	Sandy clay loam	Fruits small and oval; flesh light green; rind rather rough; fairly juicy and very acid.	do	Do.
1273	Satsumamikan mandarin	*Citrus nobilis* Loureiro	do	Fruits oval; flesh white; rind rough and loose; quality poor; juicy and acid.	do	Foreign.
5165	Suangui	*Citrus hystrix* var. *torosa* Wester	do	Fruits rather small; flesh light green; rind very rough and corrugated; not juicy and very acid.	do	Native.
3383		*Citrus madurensis* Loureiro	do	Fruits flattened; rind smooth, thin, and loose; quality poor; fairly juicy and subacid.	do	Foreign.
3671		*Citrus* sp	do	Fruits oval; flesh light yellow; rind rough and fairly loose; quality poor; fairly juicy and acid.	do	Do.

As soon as the fruits arrived at the laboratory, they were weighed and their average weights noted. It will be seen from Table 8 that of all the forms of citrus analyzed, the pomelos were the heaviest. The pink pomelo averaged 695 grams, or a little over 1.5 pounds; most of the grapefruits weighed between 400 and 500 grams, or about .1 pound per fruit. The oranges came third, the heaviest ones, Sour orange, 384.9 grams; Igorot, 375; Balanga, 265; Valencia, 207.5; Misamis, 206.6; and the rest weighed between 104 and 200. The limes were the smallest; the average weight ranged from 34 to 120.1 grams.

After having been weighed, the fruits were peeled and the average weights of the peelings noted. Then the peeled fruits were opened and the seeds removed. The average number of seeds per fruit, the average weight of seeds per fruit, and the average weight of one seed are also given in Table 8. The average weights of peelings, pulps, seeds, and juice, expressed in percentages, are given also in the table. The juice was expressed from the fruit by means of a hand press, strained through a piece of fine cloth to get rid of any pulp or seeds, measured to determine the average number of mils per average fruit, and the specific gravity determined by means of a hydrometer. Table 8 also gives the specific gravity of the juices of the different citrus fruits and the quantity of juice, in percentage, per average fruit.

It will be noted that among the oranges the Boone orange has the highest percentage of juice, 56.05; Valencia, 52.67; and Magnum bonum, 51.38. Among the other citrus fruits that are not oranges Camisan has the highest percentage of juice, 53.55. The rest range from 31 per cent up. The specific gravity was found to lie between 1.028 and 1.042.

Among the oranges, Sour orange has the highest percentage of peeling, 39.57; Jaffa has the highest percentage of pulp, 41.61; and Brown orange has the lowest percentage of peeling, 15.63. Igorot has the lowest percentage of pulp, 17.2, and Malta blood the least average number of seeds per fruit, namely, 2.5. Among the other citrus fruits that are not oranges Marsh grapefruit has the highest percentage of peeling, 38.57; Lemon the highest percentage of pulp, 39.58; Pink pomelo the highest number of seeds, 58. Trinidad lime has the lowest percentage of peeling, 19.94; Walter grapefruit the lowest percentage of pulp, 18.21; and Tahiti lime the least number of seeds, 1.

TABLE 8.—*Analyses of citrus fruits.*

P. I. No.	Name.	Average weight of fruit.	Peeling.		Pulp.		Juice.			Seeds.			
			Average weight.	Weight.	Average weight.	Weight.	Average volume.	Specific gravity.	Weight.	Average number per fruit.	Average weight per fruit.	Average weight of a seed.	Weight.
		g.	*g.*	*P. ct.*	*g.*	*P. ct.*	*cc.*		*P. ct.*	*g.*	*g.*	*g.*	*P. ct.*
3660	Balanga orange	265.0	66.66	25.15	67.87	25.61	120.5	1.033	46.97	21.7	6.0	0.276	2.26
2698	Boone orange	167.2	36.40	21.77	35.40	21.17	91.0	1.030	56.05	11.2	1.7	0.151	1.01
2695	Brown orange	160.56	25.10	15.63	52.58	32.74	78.5	1.036	50.68	8.1	1.56	0.192	0.97
4124	Carleton orange	181.90	50.08	27.53	50.22	27.60	78.0	1.028	44.08	8.1	1.50	0.185	0.82
9119	Dugat orange	162.60	44.62	27.44	56.95	35.02	57.5	1.029	36.38	10.37	1.875	0.180	1.15
2340	Igorot orange	375.00	148.00	39.46	64.85	17.20	150.0	1.029	41.16	30.5	8.00	0.262	2.13
1637	Jaffa orange	159.25	35.00	21.97	66.27	41.61	55.0	1.036	35.77	6.5	1.00	0.154	0.63
1714	Larrantta orange	146.60	41.20	28.10	43.74	29.80	51.5	1.034	40.55	16.25	2.21	0.142	1.50
	Majorca orange	125.50	32.93	26.23	31.48	25.08	58.57	1.031	48.11	3.14	0.714	0.227	0.569
1259	Malta blood orange	104.00	26.00	25.00	41.77	40.15	35.00	1.031	34.69	2.50	0.25	0.100	0.240
4123	Magnum bonum orange	164.70	32.91	19.98	45.84	27.83	82.00	1.032	51.38	6.60	1.33	0.200	0.810
2568	Misamis orange	206.60	46.90	22.70	56.12	27.19	95.00	1.034	47.54	19.30	5.35	0.277	2.59
1635	Pineapple orange	132.12	24.00	18.16	37.51	28.38	62.5	1.035	48.96	21.25	5.93	0.250	4.49
2686	Pineapple orange	165.00	43.30	26.24	48.11	29.15	66.66	1.035	41.81	16.00	4.60	0.291	2.78
5177	Pongkan orange	172.30	37.11	21.53	49.23	28.58	80.00	1.030	47.82	16.00	3.55	0.222	2.05
1618	Sampson orange	150.00	33.55	23.70	47.06	31.37	63.90	1.039	44.19	8.90	1.10	0.133	0.733
1638	Sour orange	384.90	152.30	39.57	70.60	18.34	150.00	1.032	40.21	44.00	7.20	0.163	1.870
1706	Valencia orange	207.50	45.00	21.68	51.72	24.92	106.00	1.031	52.67	7.50	1.50	0.200	0.720
1715	White siletta orange	122.00	31.00	25.40	42.70	35.04	45.00	1.040	38.36	9.50	1.50	0.157	1.140
1266	Whitaker orange	167.70	40.50	24.15	44.42	26.48	80.00	1.033	49.27	13.60	0.14	0.0103	0.083
2687	Duncan grapefruit	460.58	141.15	30.64	153.21	33.26	145.8	1.035	32.76	51.00	15.33	0.300	3.33
1313	Ellen grapefruit	280.00	98.50	35.17	75.82	27.07	98.00	1.036	36.26	23.30	4.16	0.178	1.48
1631	Marsh grapefruit	328.33	126.66	38.57	96.74	29.46	100.00	1.036	31.55	3.80	1.33	0.347	0.405
4121	McCarthy grapefruit	521.37	167.87	32.19	119.48	22.91	210.5	1.031	41.62	55.00	17.00	0.309	3.260
1334	Pernambuco grapefruit	400.00	100.00	25.00	106.73	26.68	175.0	1.033	45.19	46.00	12.50	0.271	3.125

TABLE 8.—*Analyses of citrus fruits*—Continued.

P. I. No.	Name.	Average weight of fruit.	Peeling.		Pulp.		Juice.			Seeds.			
			Average weight.	Weight.	Average weight.	Weight.	Average volume.	Specific gravity.	Weight.	Average number per fruit.	Average weight per fruit.	Average weight of a seed.	Weight.
		g.	*g.*	*P. ct.*	*g.*	*P. ct.*	*cc.*		*P. ct.*	*g.*	*g.*	*g.*	*P. ct.*
1632	Triumph grapefruit	305.00	87.00	28.52	111.11	36.43	96.0	1.038	32.67	20.00	7.25	0.362	2.37
4118	Walter grapefruit	369.60	113.20	30.60	67.33	18.21	169.16	1.037	47.46	51.83	13.66	0.263	3.69
1333	Ellen pomelo	322.50	83.00	25.73	95.73	29.68	133.00	1.032	42.56	38.50	6.50	0.168	2.01
1635	Pink pomelo	695.00	262.00	37.69	161.50	23.23	250.0	1.042	37.48	58.00	11.00	0.088	1.57
3669	Everglade lime	40.16	11.73	29.20	8.58	21.36	18.75	1.032	48.18	4.83	0.50	0.103	1.24
	Tahiti lime	120.10	36.06	30.02	26.66	22.20	55.5	1.032	47.69	1.00	0.10	0.100	0.08
3670	Trinidad lime	34.35	6.85	19.94	11.50	33.48	15.00	1.037	45.28	3.60	0.45	0.125	1.31
5175	Lemon	57.83	19.72	34.09	22.89	39.58	14.44	1.027	25.60	4.66	0.40	0.083	0.69
2502	Biasong	52.00	14.45	27.78	11.26	21.66	22.00	1.038	43.91	27.10	3.45	0.127	6.60
5497	Gauid	135.10	38.43	28.44	39.39	29.16	48.2	1.030	36.74	29.37	7.625	0.259	5.64
5658	Camisan	141.30	32.62	23.08	28.55	20.21	72.5	1.041	53.55	28.70	4.50	0.156	3.18
4827	Lombog	72.05	21.14	29.34	18.17	25.21	28.0	1.031	40.06	52.90	4.00	0.074	5.56
1273	Satsumamikan mandarin	386.00	116.00	30.05	99.51	25.77	160.00	1.036	42.94	17.50	4.25	0.242	1.10
5165	Suangui	64.00	22.08	35.65	17.40	27.18	20.00	1.038	32.43	29.90	3.04	0.101	4.75
3383	*Citrus madurensis*	109.83	29.16	28.92	34.17	33.88	33.33	1.038	34.31	13.50	2.91	0.210	2.88
3671	*Citrus* sp.	313.00	82.16	26.24	59.35	18.96	160.00	1.039	53.11	13.30	5.25	0.390	1.67

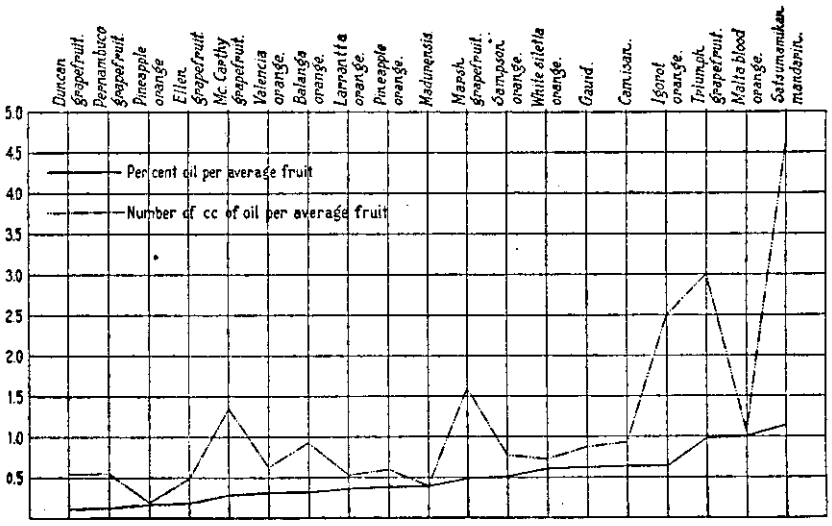

FIG. 1. Percentage and quantity of oil in various citrus fruits.

The juice was analyzed quantitatively for total solids, sucrose, reducing sugars, citric acid, and available citric acid.

METHODS OF ANALYSIS

Total solids.—Total solids were determined in the usual manner, using the steam bath and an electric oven.

Sucrose.—Exactly 26 grams of the original juice were transferred to a 100-cubic centimeter volumetric flask, clarified with alumina cream and lead subacetate solutions; made up to the 100-cubic centimeter mark; filtered and polarized in a 200-millimeter tube; and 50 cubic centimeters of the solution used, for direct polarization were inverted and the true sucrose was determined by the Clerget-Herzfeld formula:

$$S = \frac{(a-b)\ 100}{142.66 - t/2.}$$

Reducing sugars.—Determinations of reducing sugars were made by using the volumetric Fehling's method.

Citric acid.—To obtain the percentage of citric acid in an average original juice, a weighed quantity of the average juice was transferred to a beaker, diluted with a small quantity of distilled water and titrated against 0.1 *N* alkali solution, using phenolphthalein as indicator. The number of cubic centimeters of 0.1 *N* alkali used, multiplied by 0.64 and divided by the weight of the sample taken, gives the percentage of citric acid in the original juice.

TABLE 9.—*Analyses of juices in citrus fruits.*

P. I. No.	Name.	Total solids.	Sucrose.	Reducing sugars.	Citric acid in original juice.	Citric acid in juice expressed from an average fruit.	Citric acid in pulp extract.	Total citric acid in fruit.	
		P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*g.*	*P. ct.*
3660	Balanga orange	7.890	3.908	2.560	0.870	0.408	0.0332	1.136	0.421
2698	Boone orange	8.530	2.898	1.220	0.642	0.358	0.0608	0.701	0.419
2695	Brown orange	9.610	3.260	3.125	0.963	0.470	0.0685	0.865	0.539
4124	Carleton orange	7.859	3.300	2.170	0.517	0.208	0.0208	0.356	0.270
4119	Dugat orange	8.113	3.500	2.500	0.533	0.188	0.0296	0.354	0.218
2340	Igorot orange	8.104	1.950	3.844	1.294	0.515	0.0970	2.295	0.612
1637	Jaffa orange	9.702	3.970	2.971	0.682	0.235	0.0621	0.474	0.298
1714	Larrantta orange	9.167	3.520	2.856	1.254	0.491	0.0112	0.886	0.604
	Majorca orange	7.140	3.211	3.125	0.677	0.317	0.0667	0.480	0.383
1259	Malta blood orange	8.227	2.958	2.358	1.166	0.392	0.0529	0.463	0.415
4123	Magnum bonum orange	9.008	4.170	3.120	0.528	0.278	0.0700	0.575	0.319
2568	Misamis orange	9.220	4.16	2.970	0.748	0.347	0.0263	0.765	0.370
1635	Pineapple orange	10.343	4.515	2.630	0.781	0.369	0.0572	0.563	0.426
2686	Do	8.720	4.850	2.560	0.550	0.222	0.0365	0.426	0.258
5177	Pongkan orange	7.476	2.820	1.790	0.762	0.364	0.0522	0.715	0.415
1618	Sampson orange	8.490	2.271	4.440	1.620	0.690	0.0935	1.175	0.783
1638	Sour orange	8.510	1.723	3.220	2.960	1.190	0.1530	5.171	1.343
1706	Valencia orange	8.414	2.724	2.77	0.858	0.438	0.0318	0.975	0.470
1715	White siletta orange	9.860	4.850	3.10	0.680	0.250	0.0487	0.365	0.300
1266	Whitaker orange	8.930	3.180	3.33	0.691	0.340	0.0238	0.611	0.364
2687	Duncan grapefruit	9.620	2.910	2.94	1.551	0.490	0.0947	2.697	0.585
1313	Ellen grapefruit	8.620	2.400	2.53	1.76	0.616	0.0913	1.980	0.707
1631	Marsh grapefruit	9.150	2.580	3.51	1.50	0.459	0.133	1.937	0.590
4121	McCarthy grapefruit	8.216	2.810	3.12	1.232	0.443	0.271	3.723	0.714
1334	Pernambuco grapefruit	8.250	2.110	2.22	1.500	0.656	0.0925	2.998	0.749

1632	Triumph grapefruit	10.130	5.190	2.38	0.858	0.168	0.0217	0.933	0.185
4118	Walter grapefruit	9.130	2.660	3.571	1.463	0.511	0.142	2.418	0.654
1333	Ellen pomelo	8.540	2.27	2.380	1.298	0.535	0.264	2.579	0.799
1635	Pink pomelo	10.960	4.77	2.745	0.383	0.138	0.110	1.069	0.154
3669	Everglade lime	9.734	0.00	0.210	6.640	3.198	0.749	1.585	3.940
	Tahiti lime	8.474	0.00	1.692	6.840	3.160	0.563	4.472	3.640
3670	Trinidad lime	9.81	0.00	0.062	7.159	3.120	0.605	1.281	3.730
5175	Lemon	7.392	0.00	0.973	3.711	0.951	0.460	0.816	1.410
2502	Biasong	8.927	0.00	0.060	7.570	3.202	0.455	1.902	3.655
5497	Gauid	8.216	0.00	0.550	4.610	1.640	0.296	2.621	1.940
5658	Camisan	10.808	0.155	4.500	2.380	1.220	0.141	1.925	1.360
4827	Lombog	9.076	0.00	0.00	6.050	2.423	0.529	2.127	2.952
1273	Satsumamikan mandarin	9.160	0.00	3.700	3.064	1.270	0.186	5.623	1.450
5165	Suangui	10.417	0.00	0.064	6.209	2.014	0.557	1.645	2.570
3383	*Citrus madurensis*	9.020	4.85	2.740	0.510	0.168	0.0363	0.206	0.205
3671	*Citrus* sp.	10.117	1.400	4.160	2.690	1.521	0.2123	5.426	1.734

To obtain the percentage of possible available citric acid per average fruit, the percentage of citric acid in the average juice was multiplied by the average weight of juice per fruit and the total divided by the average weight of the fruit; the result, multiplied by 100, gave the average percentage of citric acid recovered from the juice expressed from an average fruit.

The total citric acid is the amount of citric acid in the whole fruit. It is calculated from the sum of the citric acid in the juice and the citric acid in the pulp.

Table 9 shows the analyses of the juices. According to this table and Plate 1, Triumph grapefruit has the highest percentage of sucrose in the original juice, namely, 5.19; and Everglade lime, Tahiti lime, Trinidad lime, Lemon, Biasong, Gauid, Lombog, Satsumamikan mandarin, and Suangui do not contain any sucrose at all.

Camisan, Sampson orange, and *Citrus* species have the highest percentages of reducing sugars; namely, 4.5, 4.44, and 4.16, respectively; Biasong, Trinidad lime, and Suangui have the lowest, 0.00, 0.062, and 0.064, respectively.

It is very interesting to note that the fruits that are high in sugars are very low in citric acid. Table 8 shows that Biasong, Trinidad lime, Tahiti lime, and Everglade lime have the highest percentages of citric acid in the juice, 7.57, 7.159, 6.84, and 6.64, respectively; they have no sucrose and very low percentages of reducing sugars.

The total citric acid per average fruit is highest in Satsumamikan mandarin, 5.623 grams, and lowest in *Citrus madurensis*, 0.206 gram. The percentages of average total citric acid per average fruit are highest in Everglade lime, 3.94; Trinidad lime, 3.73; Biasong, 3.655; and Tahiti lime, 3.64; and are lowest in Pink pomelo, 0.154; Triumph grapefruit, 0.185; *Citrus madurensis*, 0.205; and Dugat orange, 0.218.

Crystallized citric acid was prepared by the usual chalk lime method; excellent crystals were easily obtained from the mixed juice of the fruits. The percentage yield on juice was not taken.

The process used in extracting the oil from the peeling was carefully regulated steam distillation. The peeling was passed through a grinder, transferred to a distilling apparatus with a small quantity of water, and distilled. The oil that floated on top of the distillate was separated and measured. From this the average number of mils per average fruit was determined. The oil obtained by distillation differs from that obtained by expression in that the distilled oil is practically colorless and does

not have the bitter taste of the yellow expressed oil. The non-volatile matter present in the oil obtained by pressing is absent in distilled oil.

Table 10 and fig. 2 show that Satsumamikan mandarin is highest in both volume and percentage of oil per average fruit.

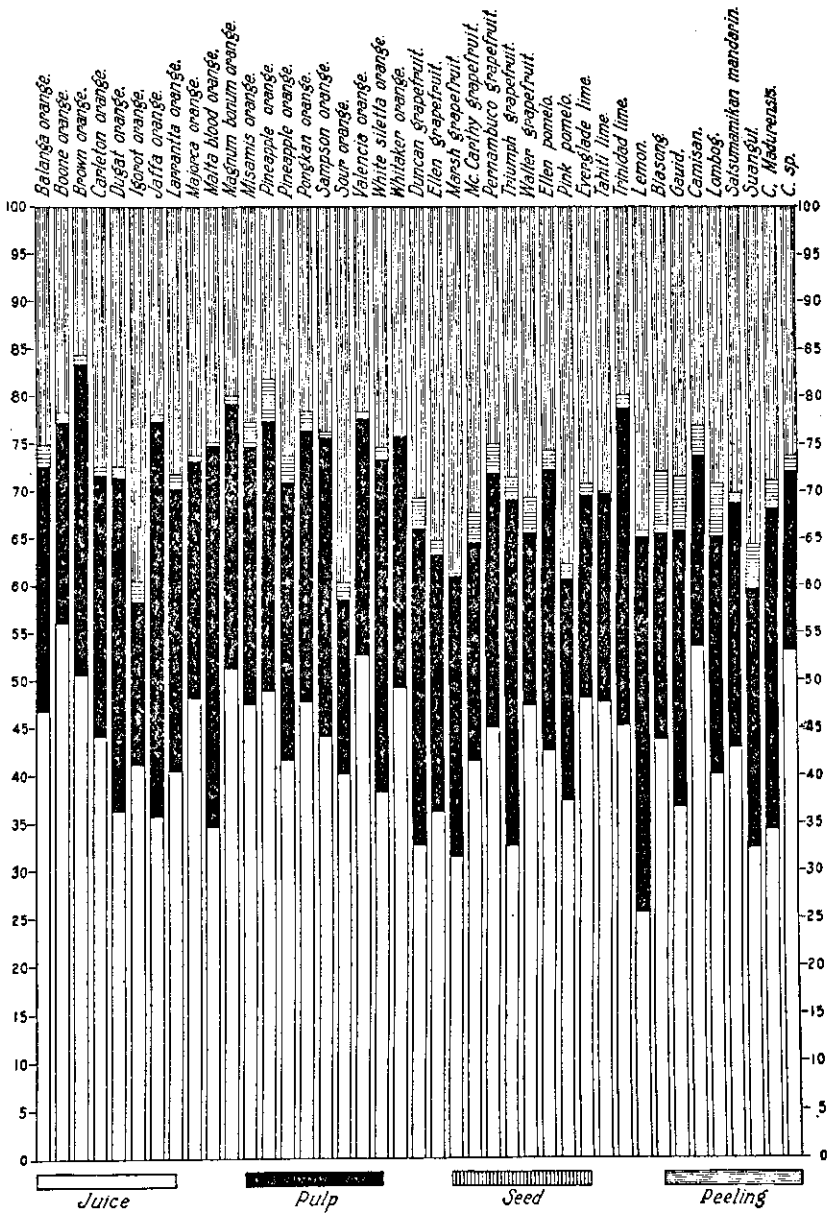

FIG. 2. Juice, pulp, seed, and peeling in various citrus fruits.

Duncan grapefruit has the lowest percentage of oil per average fruit, and pineapple orange the least volume of oil per average fruit.

TABLE 10.—*Showing volume and percentage of oil in citrus fruits.*

P. I. No.	Name.	Oil in whole fruit.	Oil per average fruit.
		Per cent.	*mils.*
2687	Duncan grapefruit	0.115	0.53
1334	Pernambuco grapefruit	0.137	0.55
1685	Pineapple orange	0.143	0.19
1313	Ellen grapefruit	0.172	0.483
4121	McCarthy grapefruit	0.258	1.350
1706	Valencia orange	0.301	0.625
3660	Balanga orange	0.347	0.920
1714	Larrantta orange	0.360	0.525
2686	Pineapple orange	0.363	0.600
3383	*Citrus madurensis*	0.380	0.383
1631	Marsh grapefruit	0.487	1.600
1618	Sampson orange	0.510	0.766
1715	White siletta orange	0.600	0.730
5497	Gauid	0.638	0.862
5658	Camisan	0.663	0.937
2390	Igorot orange	0.660	2.500
1632	Triumph grapefruit	0.983	3.000
1259	Malta blood orange	1.000	1.05
1273	Satsumamikan mandarin	1.190	4.60

As has been previously mentioned the Philippines, excepting Cotabato Province, is very well adapted to citriculture. In spite of this fact, however, hundreds of thousands of pesos worth of pomelos, lemons, and oranges are imported annually into the Philippines from the United States, Italy, Spain, British East Indies, Dutch East Indies, Guam, Australasia, Australia, Canada, Japan, and China.

To verify this statement the data obtained from the Bureau of Commerce and Industry are here presented as Table 11.

TABLE 11.—*Annual imports of citrus fruits into the Philippine Islands for 1913 to 1923.*

Import and source.	Weight.	Value.
1913		
Lemons:	*Kgs.*	*Pesos.*
United States	35,571	9,274.00
Italy	106,977	16,880.00
Spain	20	2.00
Australasia	1,638	338.00
Total	144,206	26,494.00

TABLE 11.—*Annual imports of citrus fruits into the Philippine Islands for 1913 to 1923*—Continued.

Import and source.	Weight.	Value.
	Kgs.	*Pesos.*
Oranges: **1913**		
United States	75,151	16,158.00
China	229,572	12,444.00
British East Indies	1,056	56.00
Japan	19,370	1,818.00
Australia	4,868	1,260.00
Total	330,017	31,736.00
Grand total		58,230.00
Lemons: **1914**		
United States	61,165	16,068.00
Guam	16	2.00
Italy	46,386	10,866.00
Australasia	518	160.00
Total	108,085	27,096.000
Oranges:		
United States	140,563	24,136.00
China	388,206	22,828.00
Japan	22,145	2,184.00
Australia	3,524	912.00
Total	554,438	50,060.00
Grand total		77,156.00
Lemons: **1915**		
United States	126,903	23,522.00
Italy	5,000	1,066.00
Australasia	46	10.00
Total	131,949	24,598.00
Oranges:		
United States	147,149	26,229.00
China	355,225	22,025.00
Japan	31,461	3,225.00
Australia	781	208.00
Total	534,616	51,687.00
Grand total		76,285.00
Lemons: **1916**		
United States	127,886	29,003.00
Australia	438	61.00
Total	128,324	29,064.00
Oranges:		
United States	196,231	38,492.00
China	628,386	33,499.00
Dutch East Indies	1,125	145.00
Japan	16,854	1,592.00
Total	842,596	73,728.00
Grand total		102,792.00

TABLE 11.—*Annual imports of citrus fruits into the Philippine Islands for 1913 to 1923*—Continued.

Import and source.	Weight.	Value.
1917	*Kgs.*	*Pesos.*
Lemons:		
United States	117,210	32,309.00
Oranges:		
United States	236,529	48,674.00
Canada	1,850	320.00
China	332,737	21,316.00
British East Indies	73	2.00
Dutch East Indies	1,066	178.00
Japan	12,027	1,107.00
Total	584,282	71,597.00
Grand total		103,906.00
1918		
Lemons:		
United States	76,332	29,575.00
China	401	56.00
Australia	183	19.00
Total	76,916	29,650.00
Oranges:		
United States	185,855	73,905.00
China	411,363	39,494.00
British East Indies	32	4.00
Japan	5,718	709.00
Australia	101	30.00
Total	603,069	114,142.00
Grand total		143,792.00
1919		
Lemons:		
United States	110,644	33,472.00
China	718	79.00
Total	111,362	33,551.00
Oranges:		
United States	295,991	105,334.00
China	372,393	47,453.00
British East Indies	341	61.00
Japan	1,800	287.00
Total	670,525	153,135.00
Grand total		186,686.00
1920		
Lemons:		
United States	170,911	50,765.00
Italy	2,530	770.00
China	256	294.00
Australia	1,986	350.00
Total	175,683	52,179.00

TABLE 11.—*Annual imports of citrus fruits into the Philippine Islands for 1913 to 1923*—Continued.

Import and source.	Weight.	Value.
1920	*Kgs.*	*Pesos.*
Oranges:		
United States	596,767	239,492.00
China	236,341	45,661.00
British East Indies	2,599	355.00
Japan	7,580	1,362.00
Australia	451	156.00
Total	843,738	287,026.00
Grand total		339,205.00
1921		
Lemons:		
United States	321,944	74,686.00
Italy	5,000	97.00
China	173	9.00
Total	327,117	74,792.00
Oranges:		
United States	1,022,007	300,129.00
Spain	500	65.00
China	1,139,892	136,643.00
British East Indies	771	129.00
Japan	12,382	1,846.00
Total	2,175,552	438,812.00
Grand total		513,604.00
1922		
Lemons:		
United States	177,951	60,458.00
China	1,283	456.00
Australia	1,100	320.00
Total	180,334	61,234.00
Oranges:		
United States	393,591	157,280.00
China	739,302	81,247.00
Japan	7,427	813.00
Australia	30,300	9,147.00
Total	1,170,620	248,487.00
Pomelos:		
United States	27	10.00
Spain	14	4.00
China	304,681	19,048.00
British East Indies	817	50.00
Japan	30	4.00
Total	305,569	19,116.00
Grand total		328,837.00

TABLE 11.—*Annual imports of citrus fruits into the Philippine Islands for 1913 to 1923*—Continued.

Import and source.	Weight.	Value.
1923	*Kgs.*	*Pesos.*
Lemons:		
United States	177,500	65,694.00
Italy	8,030	1,603.00
Canada	160	60.00
Total	185,690	67,357.00
Oranges:		
United States	1,167,496	334,306.00
China	815,360	99,194.00
British East Indies	1,140	131.00
Japan	5,890	943.00
Total	1,989,886	434,574.00
Pomelos:		
China	167,532	10,854.00
British East Indies	170	14.00
Total	167,702	10,868.00
Grand total		512,799.00

Considering the total amount of citrus fruits imported by the Philippines every year, as shown in Table 11, it would seem that the Filipinos are heavy consumers of citrus fruits. The yearly increase in the total value of citrus fruits imported indicates that the future demand will be far greater than is the present.

It is very unfortunate that the Philippines, with its climate and soil well suited to citriculture, must depend upon foreign countries for its supply of citrus fruits. Authorities on citriculture agree that if cultivation of the different kinds of citrus were given more attention here the Philippines would unquestionably produce equally good and possibly better fruits than those now being imported. With the exception of Batangas mandarins, however, the Philippine citrus fruits are classed as very poor. Wester [5] makes the following statement about Batangas mandarins:

> Perhaps nowhere else in the world have such superior mandarins been produced in such quantities and with so little care as in the so-called orange district of Batangas.

The Bureau of Agriculture is trying to help the Filipinos understand the value of employing proper methods of citrus

[5] Philip. Bur. Agr. Bull. No. 27 (1913) 9.

cultivation. The Tanauan Commercial Citrus Station, situated in Tanauan, Batangas Province, employs trained men to demonstrate the modern and most profitable ways of citriculture; but, strange to say, despite this effort the Batangas orange orchards yield poorer crops every year, and are being transformed by their owners into coconut plantations. This is unfortunate; for, if proper ways of cultivation were used, the yields of citrus fruits could without any doubt be increased. There is always a steady normal market in Manila for citrus fruits, whereas that for coprax is somewhat unstable. By planting coconuts to take the place of oranges (already giving returns to the owner), capital will be wasted in that a good source of income is cut off and the owner will have to wait at least six years before he can expect any return from his coconut plantation.

To encourage citriculture in the Philippines very many kinds of foreign citrus trees have been imported into the Islands and these are now growing at the Lamao Experiment Station, Lamao, Bataan Province. When Mr. Tanaka, a Japanese engaged in the study of citrus trees, came to the Philippines in 1923 to see the Lamao Experiment Station, he remarked that it has the most complete collection of citrus trees in the world.

We noted with pleasure, on a visit to Lamao Experiment Station, that some of the oranges and pomelos growing there are not at all inferior to the Chinese and California oranges in quality and sweetness, judging from the fruits we were privileged to sample. It is to be regretted that up to the present time not a single modern citrus orchard of private ownership can be found in the Philippines. The orchards in Tanauan, Batangas, which supply the Manila markets with oranges and mandarins, furnish conclusive proof of mismanagement and neglect on the part of our citrus growers. Too closely planted citrus trees, which are the hosts not only of disease, but of different plant parasites as well, are not an uncommon sight in orange districts. Wester,[6] in a discussion of citriculture in the Philippines, says—

> the first modern citrus orchard intelligently laid out and cared for is still to be planted in the Philippines.

Cavite is the only province that may in the near future compete with Batangas in the production of citrus fruits. Information from the Bureau of Agriculture is to the effect that Cavite orders citrus budded plants and seedlings by the thou-

[6] Philip. Bur. Agr. Bull. No. 27 (1913) 9.

sands and oftentimes that bureau is not able to supply the demand.

When Philippine farmers begin to realize the innumerable ways in which the many varieties of citrus serve us and the world as a whole, they will certainly regret having neglected an important industry which could have brought wealth to them and to the Philippines. If they could be made to understand that the hundreds of thousands of pesos expended for oranges, lemons, pomelos, citric acid, bitter orange peel, sweet orange peel and its tinctures, and the different oils that are annually being imported could be used for the extension and development of Philippine agricultural resources, they would possibly awaken to the advantages of citriculture at home.

The following citrus species are recommended by the Bureau of Agriculture for planting, taking into consideration productivity, quality, and flavor of the fruit. The numbers are the plant introduction numbers of the Bureau of Agriculture.

Citrus sinensis:
- 2568. Misamis.
- 3660. Balanga.
- 4119. Dugat.
- 1635. Pineapple.
- 2686. Pineapple.
- 4124. Carleton.
- 1259. Malta blood.
- 1270. St. Michael.
- 4123. Magnum bonum.
- 2694. Majorca.
- 1705. Mediterranean.
- 1636. Washington navel.
- 2689. Enterprise.
- 3886. Du Roi.
- 1260. Excelsior.
- 1719. Jaffa.
- 56. Jaffa.
- 1714. Larrantta.
- 1728. Cuyo.
- 1715. White siletta.
- 2698. Boone.
- 1720. Bahia.
- 2691. Homosassa.

Citrus aurantifolia:
- 3670. Trinidad.
- 3669. Everglade.

Citrus maxima:
- 3673. Siamese.
- 3442. Siamese.
- 3391. Yugelar.
- 1631. Triumph.
- 1713. Triumph.

Citrus nobilis:
- 1271. Kishiu.

Citrus mitis:
- 2513. Kalamondin.
- 2255. Kalamondin.
- 2332. Kalamondin.

USES OF CITRUS FRUITS

The uses of citrus fruits are many and are as follows:

Root.—The root of *Citrus acida* is one of the principal ingredients in a preparation of iron called "Yakridari lauha" used by the natives of India as a medicine.[7] The bark of the roots has also been used in the West Indies as a febrifuge.

[7] Pharm. Indica 1 (1889–1890) 270.

Gum.—In Brazil, a gum which exudes in quantity from the trunk of a kind of pomelo, *Citrus maxima*, when it begins to decay, is used as a remedy for coughs. In the Philippines the gummy exudate of the tree is used in kidney and bladder disorders.

Leaves.—An infusion made from orange leaves is used by the Filipinos in an ailment called "mal de madre." Orange leaves are official in the Swiss and Spanish Pharmacopœias. The leaves of lemon have alexipharmic properties. Besides being used for medicinal purposes the leaves are also used as flavoring in homemade *patis.*[8] Many Filipinos use the leaves in the well-known *gogo* shampoo.[9]

Flowers.—A tea made from orange flowers is commonly used in French domestic medicine. Water distilled from orange flowers is employed as an antispasmodic and as a sedative in nervous and lupteric cases.[10] Orange flower sirup, orange flower water, and stronger orange flower water are official preparations from orange flowers, in the United States Pharmacopœia. The orange-flower waters are used as a pleasant lotion and as a vehicle for other drugs. The oil of orange flowers, often called oil of neroli, a volatile oil distilled from the fresh flowers of the bitter orange, *Citrus aurantium amara* Linnæus, is official in the National Formulary. Oil of neroli is used almost exclusively in making perfumery, but in the form of orange flower it serves as a flavoring agent in sirups, elixirs, etc.

Fruits.—The seeds of lemons have tonic and antiseptic properties. They form one of the important constituents in cocimiento antiseptico (decoctum antisepticum) and cocimiento antiseptico purgante (decoctum antisepticum purgans), official preparations in the Spanish Pharmacopœia.

Orange pulp as well as lemon, pomelo, and grapefruit pulps furnish good material for paper making. Dovey[11] experimented in 1911 in making paper from citrus fruit pulp. His method was simply agitating the pulp with water and discarding the seeds that settled at the bottom; the pulp was disintegrated with bleaching powder and then passed through a sieve; from

[8] A kind of sauce prepared from fish or shrimps.

[9] Made from the pounded bark and trunk of the gogo vine, *Entada scandens* Bentham.

[10] Pharm. Indica 1 (1889–1890) 270–271.

[11] Philip. Journ. Sci. § A 7 (1912) 411.

this, sheets of paper were made by hand. The paper was semitransparent and waterproof and resembled a film of gelatin. Writing or printing was legible. With the use of simple and inexpensive machinery probably a very useful transparent and waterproof paper could be made of this pulp.

Volatile oils are obtained from the peelings of the different varieties of citrus. Oil of lemon and oil of sweet orange are official in the United States Pharmacopœia, and oil of bitter orange is official in the National Formulary. Bitter orange peel, sweet orange peel, and lemon peel are also official in the United States Pharmacopœia.

Oil of lemon is valued according to its aldehyde content; the United States Pharmacopœia requires not less than 4 per cent of aldehyde calculated as citral. Oil of lemon possesses stimulant and aromatic properties, but it is usually employed in medicine to impart an agreeable odor to preparations.

Oil of orange is about 90 per cent limonene. About 5 per cent of the remainder consists of the principal odor bearers, such as citral and citronellal. The oil is used in medicine to assist in disguising the disagreeable taste of medicaments. In small amounts it is also used to relieve nausea and colic. The peel of oranges is used in medicine as a carminative or a stomachic. In small doses it is used in nausea and colic. Fresh rind is rubbed on the face by people suffering from acne. The rind is mixed with water and then rubbed on a part affected with eczema. Orange peel is useful for checking vomiting and destroying intestinal worms.[12] The preparations made from orange peel recognized by the United States Pharmacopœia are the following: Fluid extract of bitter orange peel, tincture of bitter orange peel, tincture of sweet orange peel, and sirup of orange. Compound wine of orange is recognized by the National Formulary. Other preparations made from orange peel mentioned by the National Dispensatory are infusion of orange peel and compound infusion of orange peel.

The peelings of oranges contain the following, which account for the bitter taste: Naringin (de Virjs hesperidin or aurantin), aurantimarin, isohesperidin (glucosides), and aurantimaric acid, a resinous substance. Dried flowers of pomelo contain 2 per cent hesperidin.

Lemon peel is a stimulant stomachic and is also used in preparations to increase their efficacy and modify their taste.

[12] Pharm. Indica 1 (1889–1890) 271.

Tincture of lemon peel is recognized by the United States Pharmacopœia. The tincture enters into the manufacture of several flavoring preparations.

Lemon juice, orange juice, and the juices of citrus varieties are used for medicine and for food. Lemon juice has been recommended in rheumatic fever and in catarrhal jaundice. In the form of lemonade it affords an excellent beverage during the course of acute febrile affections. In India the juice is used for the relief of dyspepsia with vomiting. Gibson [13] says that the fruit of common sour limes, eaten daily with salt, is a remedy of the utmost importance in enlargement of the spleen. Aitkin [14] reports that a decoction of lemon is a valuable remedy in the treatment of ague. Lemon juice is also useful in bilious headache and vomiting caused by excess of bile, and in purifying the blood of scorbutic patients. With honey it is often used for alleviating sore throat and coughs. It has some digestive properties. In Bengal a pickle is made from lemon fruit and used for the the relief of indigestion. The pickle is made by rubbing the fruit on a stone or by scraping the rind; it is then steeped in juice obtained from other lemon fruit, to which has been added a little salt. Then the steeped fruit is exposed to the sun for a few days. When crisp and of a brown color the fruits are preserved in a jar. This preparation is called "jarak nebu," which means digestive lemon. The juice is also used as an antidote to some acro-narcotic poisons.

In 1912 Gibbs and Agcaoili [15] made investigations as to the possibilities of bottling orange, lemon, and other citrus fruit juices. They made about seventy bottles of orange juice with varying amounts of sugar. Sterilization was effected by immersing the stoppered bottles in boiling water for a period of from forty-five minutes to two hours. Some of the bottled juice was sterilized by filtration through a Berkefeld filter. Juices bottled with 15 per cent sugar proved to be the best. The juice kept for years. At about the same time they also made a distilled beverage from fermented and distilled juices. The flavor of the beverage was very good and improved by aging in wood for a short period. From the success of their experiments we may accept the idea that the industry of bottling Philippine citrus fruit juices would prove profitable, especially when it is remembered that the pulp which will form

[13] Pharm. Indica 1 (1889–1890) 273.
[14] Brit. Med. Journ. (October 4, 1884) 653.
[15] Philip. Journ. Sci. § A 7 (1912) 408–410.

as a by-product can be made into paper and that the oil extracted from the peelings will also be of commercial importance.

The juices of many Philippine citrus fruits, especially those of limes, are sources of citric acid, official in the United States Pharmacopœia. If the growing of Tahiti, Trinidad limes, and Biasong be encouraged, the Philippines will be able to decrease the imports of another product, namely, citric acid, which is very widely used in medicine. Citric acid increases the acidity of urine and the coagulability of the blood in scurvy, in which disease it is the best remedy for prophylactic and curative treatment. The importance of citric acid in pharmacy will be appreciated if the number of preparations in the United States Pharmacopœia of which it is a constituent part is considered. These are: solution of magnesium citrate; citrate caffein; syrup of citric acid; solution of potassium citrate; effervescent potassium citrate; ammonium ferric citrate; iron and quinine citrate; lithium citrate; potassium citrate; sodium citrate and many others mentioned by the National Dispensatory.

CONCLUSIONS

The commercial uses of citrus fruits as well as their uses in pharmacy and medicine have been pointed out, and the suitability of the Philippines for their cultivation, the possibilities in paper making and in bottling citrus juices, and the commercial value of the oils from the different varieties have been explained. Citriculture should by all means be encouraged so that the Philippines, instead of being an importer will become the leading producer and exporter of the various citrus fruits, bottled citrus juices, perfumes, orange peel, orange oil, lemon peel, lemon oil, citric acid, oil of neroli, and the many pharmaceutical preparations made from these.

ILLUSTRATIONS

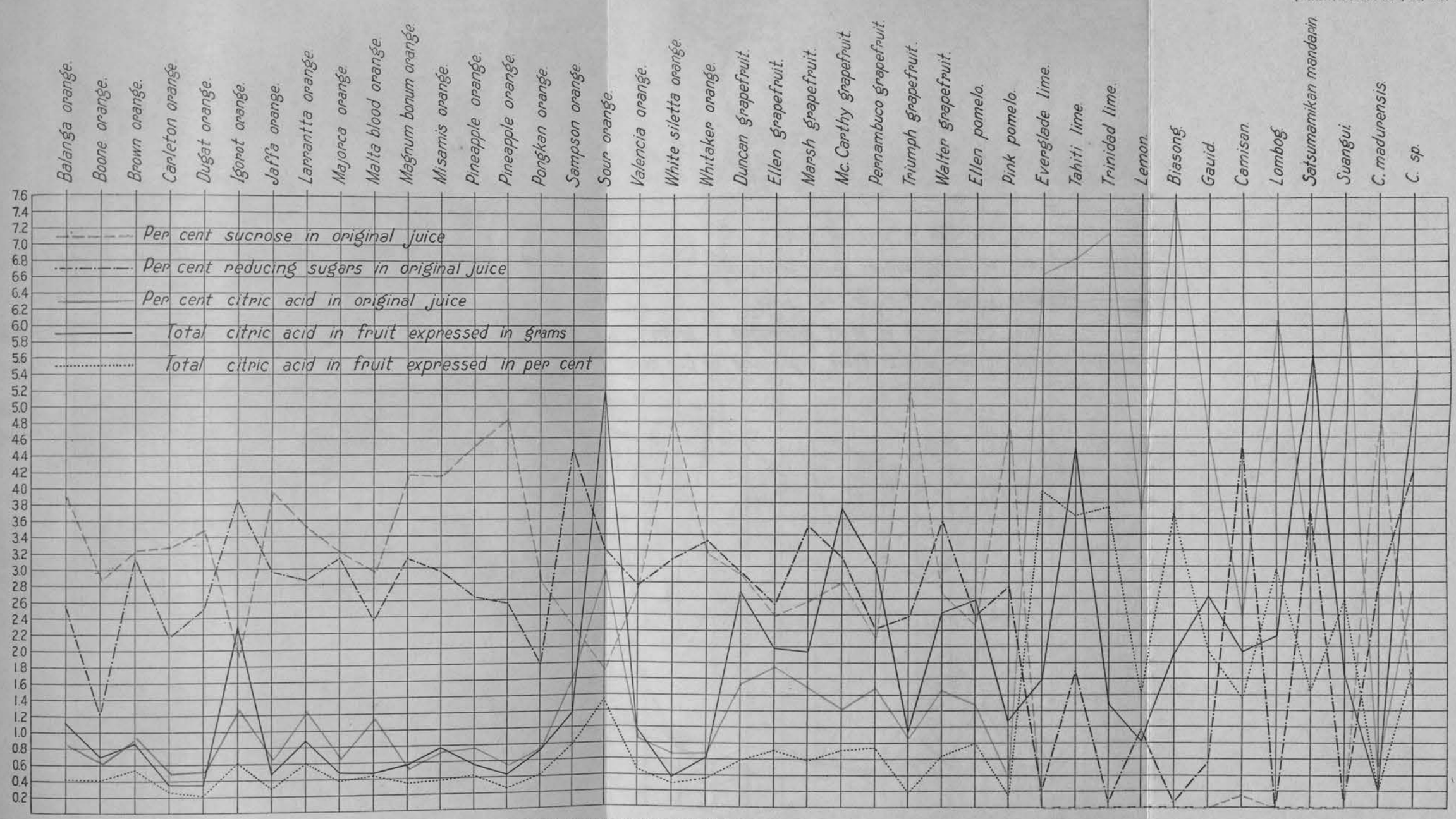

PLATE 1. SUCROSE, REDUCING SUGARS, AND CITRIC ACID IN CITRUS FRUITS.

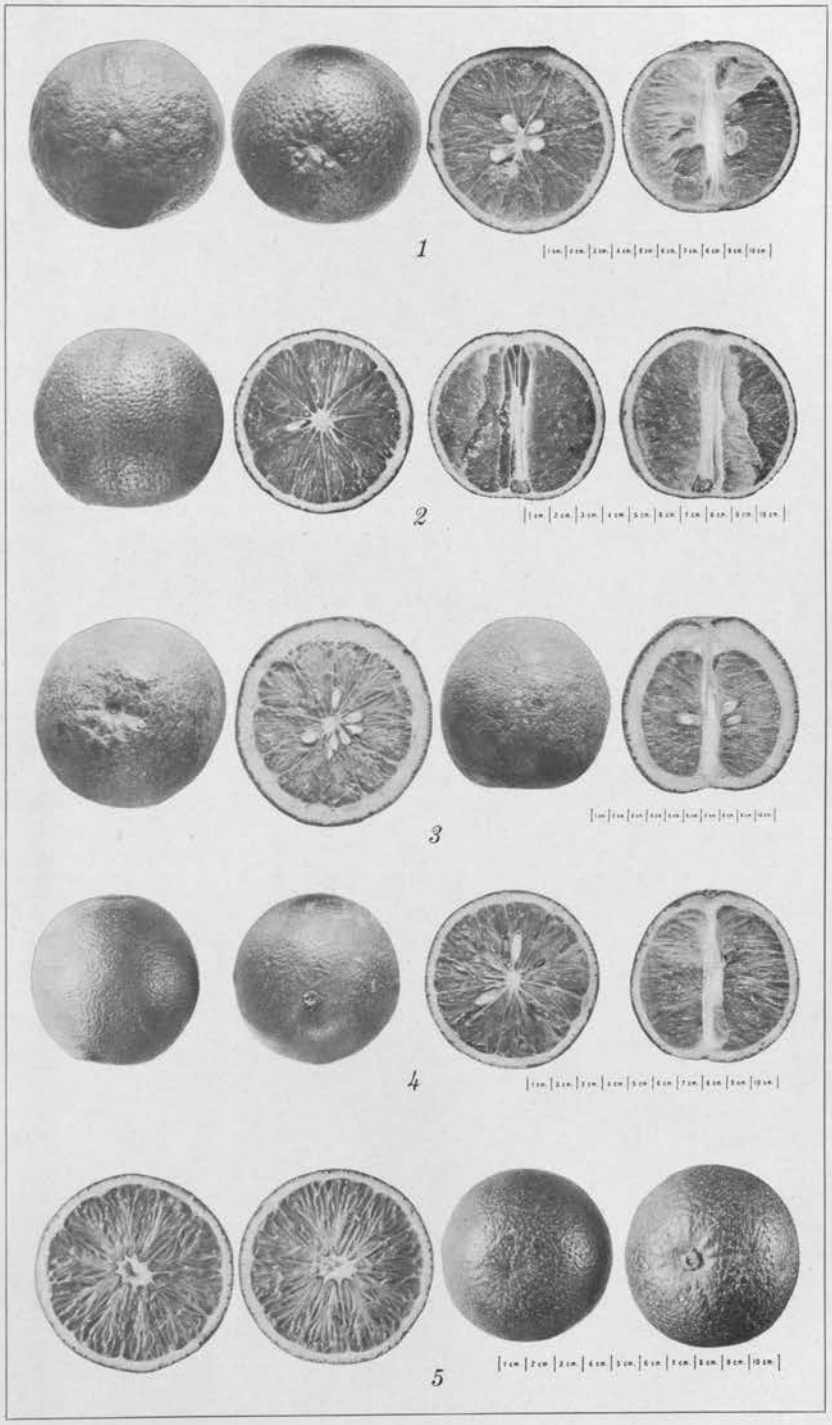

PLATE 2.

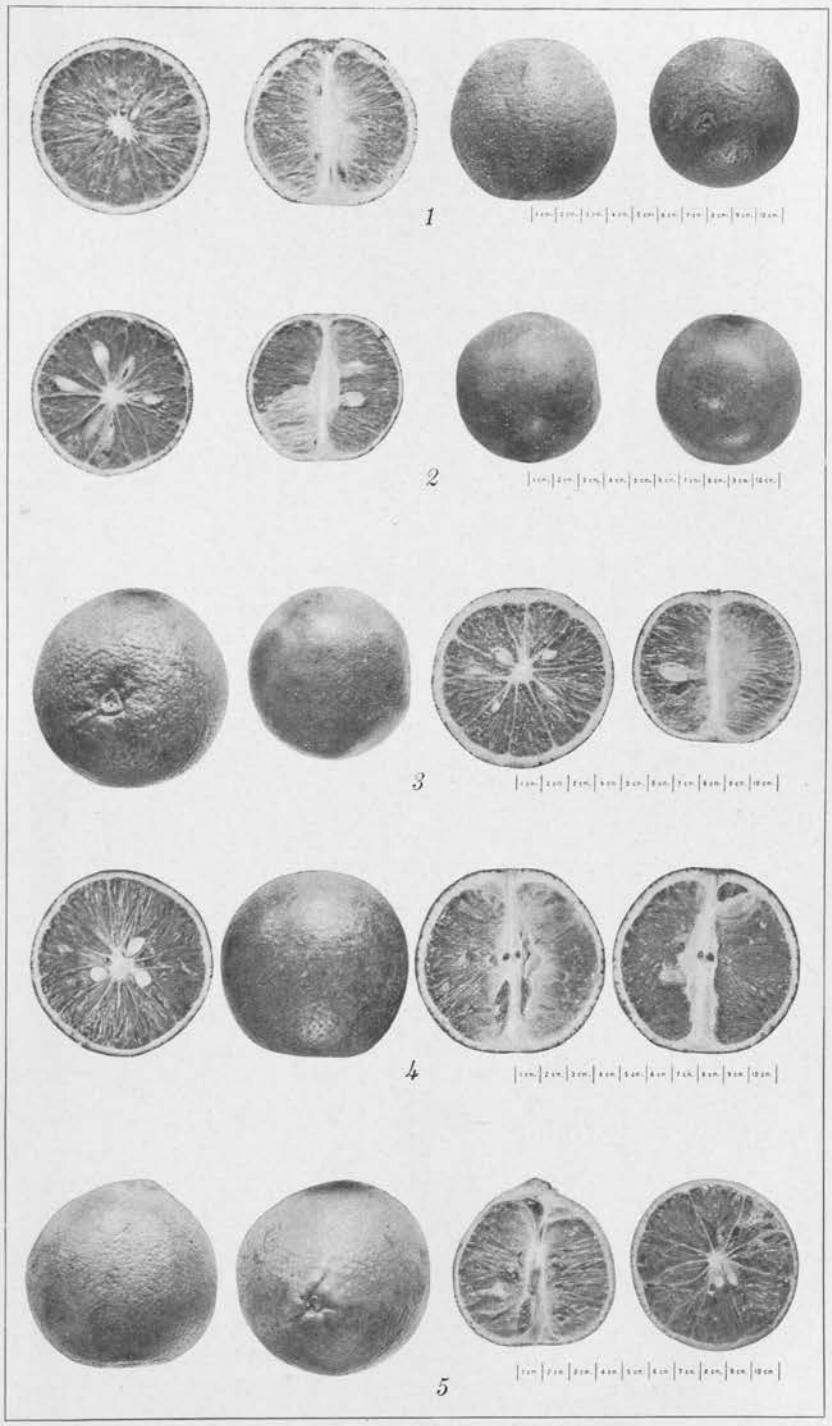

PLATE 3.

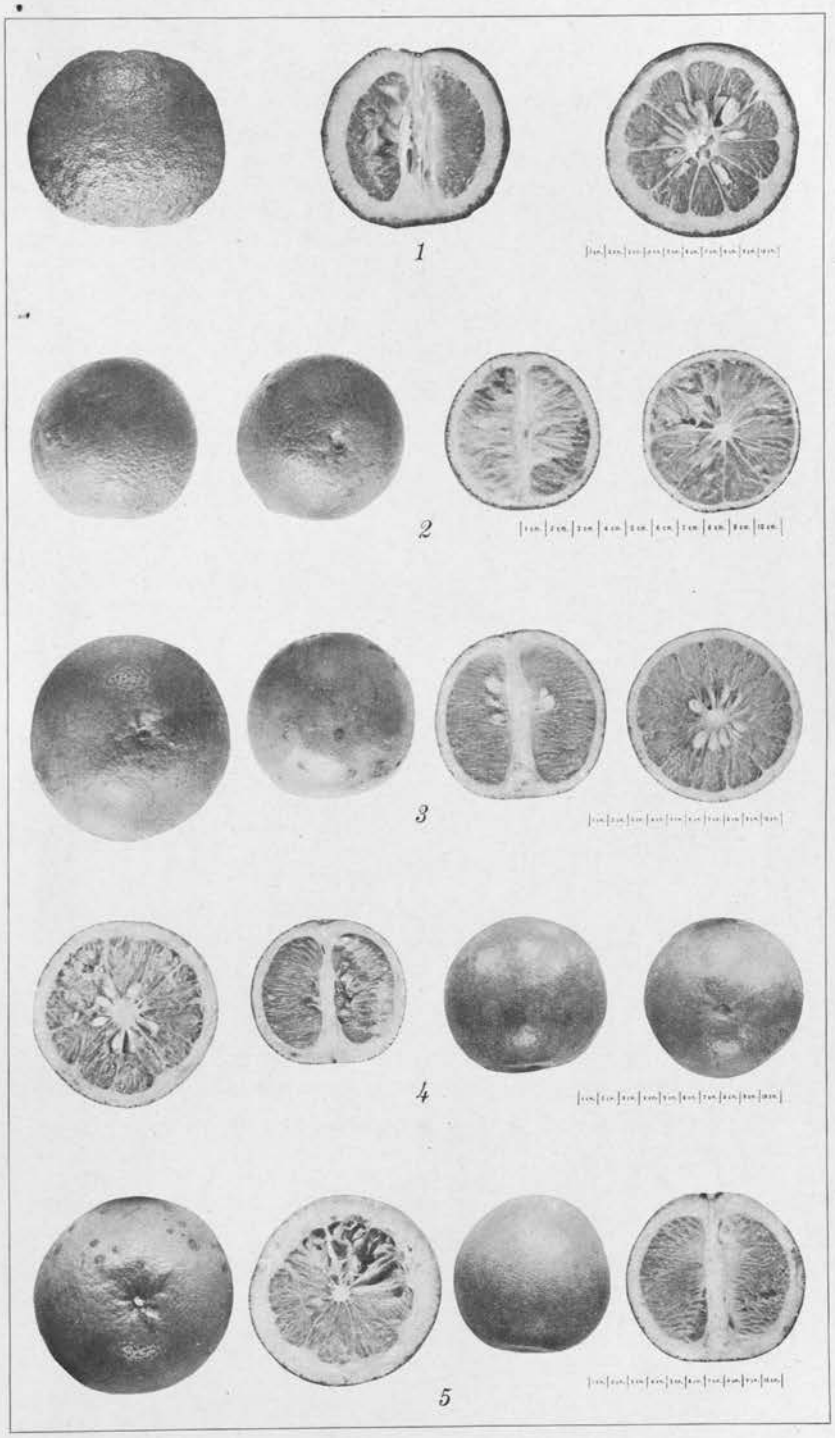

PLATE 4.

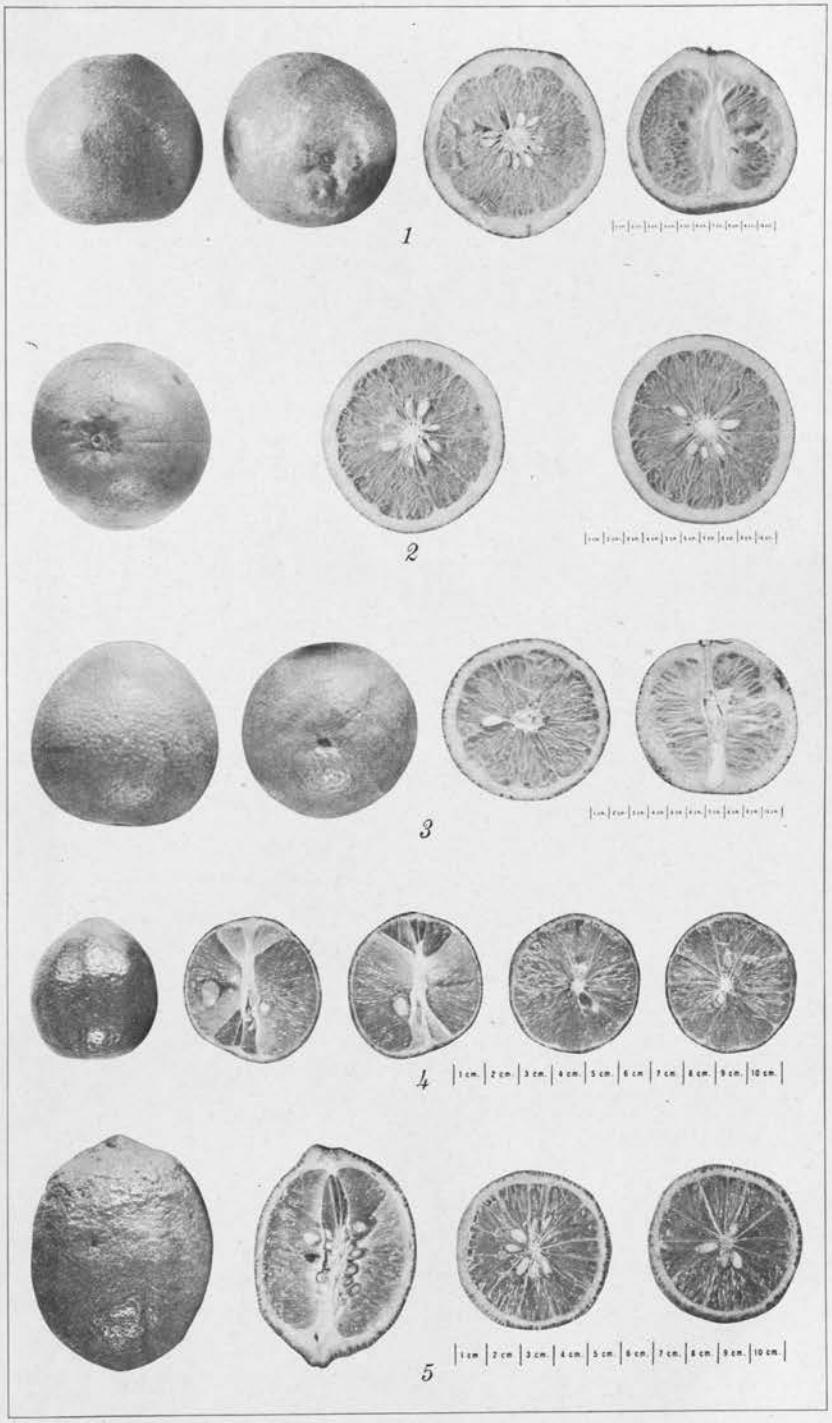
1
2
3
4
1 cm. 2 cm. 3 cm. 4 cm. 5 cm. 6 cm. 7 cm. 8 cm. 9 cm. 10 cm.
5
1 cm 2 cm 3 cm 4 cm 5 cm 6 cm 7 cm 8 cm 9 cm 10 cm

PLATE 5.

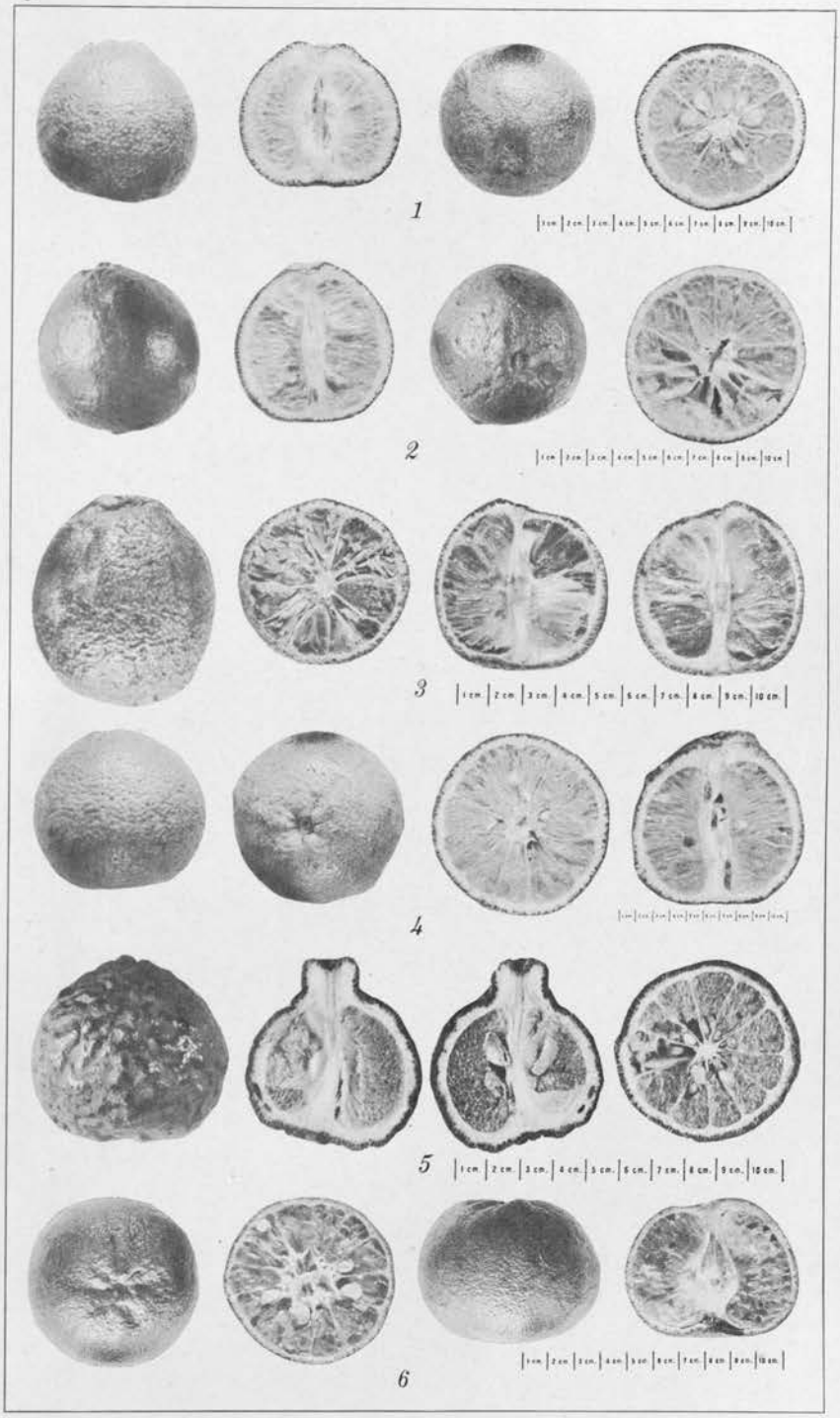

PLATE 6

A PHARMACOGNOSTICAL STUDY OF CHENOPODIUM AMBROSIOIDES LINNÆUS FROM THE PHILIPPINES

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FIVE PLATES

Of the genus *Chenopodium*, which comprises about fifty species distributed in various regions of the world, only two or three species are particularly interesting on account of the medicinal value of the volatile oil obtained from them, and three or more other species because of their food value. The knowledge of the virtue of the oil of chenopodium as a medicine for expelling intestinal worms can be traced for many years. Schüffner and Vervoort(12) claim that this oil is superior even to thymol, beta-naphthol, or eucalyptus. In their comparative studies upon various drugs for the treatment of hookworm infection they determined the "coefficient of efficacy" of each to be as follows: Oil of eucalyptus, 38; beta-naphthol, 68; thymol, 83; oil of chenopodium, 91. Their results were strongly supported by the many cases observed and reported by Levy,(6) assistant resident physician of Johns Hopkins Hospital.

The oil of chenopodium, or oil of American wormseed, which is readily obtained by distillation, is official in the United States Pharmacopœia IX as *Oleum chenopodii*. The fruit of *Chenopodium* was formerly official but was dropped from the United States Pharmacopœia in 1900.

The chemical constituents and the pharmacological and therapeutical properties of the oil of chenopodium have been extensively worked out during the latter part of the present century, especially during the period of the World War. The most important components of the oil are cymene and ascaridol; the latter was first isolated by Schimmel and Company,(11) who gave it the name "ascaridol." They believed the anthelmintic action of the oil to be due to this compound. Livingston(7) has definitely shown that ascaridol is the most toxic component of the oil. Kobert,(5) on the other hand, claims that the anthelmintic action of the powdered drug is due to the presence of the

two saponin bodies as well as to the essential oil. These two saponin bodies were detected by him in the herbs and seeds, in his investigations of the plant.

The principal source of the oil is the mature plant of *Chenopodium ambrosioides* var. *anthelminticum* A. Gray, which is extensively cultivated in Maryland (particularly near Baltimore) and in Missouri.

Aug. Chevalier(2) describes two varieties of *Chenopodium ambrosioides* as important sources of the oil of chenopodium; the variety *anthelminticum* A. Gray = *C. anthelminticum* Linnæus = *C. ambrosioides* Linnæus subsp. *anthelminticum* Thellung, and the variety *santamaria* A. Chev. = *C. santamaria* Vellozo de Miranda. He also points out that the oil obtained from the following species has the same anthelmintic properties: *Chenopodium ambrosioides* Linnæus, *C. botrys* Linnæus, *C. multifidum* Linnæus, and *C. chilense* Schrader.

In China, *Chenopodium album* Linnæus, known as *jui-t'iao* or *jui-hsien*, is described in the Chinese Materia Medica(15) as having medicinal properties. Thus, the stalk and the leaves of the plant are thought to have insecticidal properties, and they are also used in cases of insect stings and bites; the seeds are eaten as an anthelmintic remedy, and the expressed juice is used for eradicating freckles and sunburn.

However, Pynaert(9) considers the following species as important sources of the oil of chenopodium: *Chenopodium ambrosioides* Linnæus, *C. ambrosioides* var. *anthelminticum* A. Gray = (*C. anthelminticum* Linnæus), and *C. suffruticosum* Willdenow. Of these only *C. ambrosioides* Linnæus is found in the Philippines, where it is widely distributed. It constitutes the most available local source of oil of chenopodium and, therefore, it seemed that a thorough investigation as to what part of the plant might be best used for distillation of the oil was desirable. Recently Jimenez(4) distilled the oil from *Chenopodium ambrosioides* Linnæus, growing in the Philippines. In his unpublished paper, read before the Convention of the Philippine Pharmaceutical Association in 1922, he claims that the oil obtained by him is identical with the oil isolated from the var. *anthelminticum*.

Microchemical detection of the oil.—As *Chenopodium ambrosioides* Linnæus owes its curative properties to the presence of a volatile oil, and since there are somewhat conflicting ideas with respect to the parts to be used in its preparation, a microscopical study of the plant was undertaken with the purpose of

getting more or less definite information about the part or parts in which the oil is secreted and stored abundantly. The various parts of the plant were examined critically. Sections of the leaf, the young and the old portions of the stem, the open and the unopened flowers, the fruits, and the seeds were made and treated with some of the important reagents commonly used for the microchemical detection of essential oils in general. The following were used: Five per cent solution of potassium hydroxide in 95 per cent alcohol, freshly prepared alkanet tincture, osmic acid, Sudan red, and aqueous solution of copper acetate. Among these reagents the first, Wirth's(16) alcoholic potash, gave the best results. The reaction consists in the gradual change of color of the oil from a deep yellow to various shades of orange, then to deep red, and finally to dark reddish brown. The time observed for the whole reaction is very much shorter than that given by Wirth(16) for the variety *anthelminticum*, perhaps due to the fact that room temperature is higher in the Philippines than in the United States. The change in color of the oil was noticed in from two to three minutes after the addition of the reagent. The advantage of this reagent over the others lies in the fact that the reaction is much more rapid, perhaps due to its destructive effect on the cell walls, thus allowing it to reach the oil quickly. Its disadvantage is that, if the aldehydes are not completely removed or eliminated, judgment of the change in colors is very unsafe.

The alkanet tincture was next in efficiency to the alcoholic potash. This reagent also gave satisfactory results, particularly with the oil found in the embryo. It does not readily react with the oil stored in the uninjured glands, but if the walls of the glands are broken the reaction is observed, thus showing that the cutinized walls of the glandular hairs retard the penetration of the alkanet. However, if the glands are left very long in the alkanet tincture a slow reaction is obtained. The disadvantage of this reagent is that it dissolves the oil and the color disappears. Osmic acid and Sudan red gave good results also, but the aqueous solution of copper acetate failed to give any. As controls, tests were made on the oil prepared by Eimer, Amend and Company, New York, and practically the same results were obtained.

General characters of the hairs.—Two distinct kinds of hair are observed in *Chenopodium ambrosioides* Linnæus, both of the multicellular type. They are seated either on one prominent epidermal cell or between two such cells. Only one type of hair

secretes and stores the oil, and this is considered by Solereder (13) as the true glandular hair (Plate 2, figs. 24*a* to 24*f*). It is composed of a basal portion consisting of two or more superimposed cells, which have rather thick walls and sometimes in the younger stage contain chloroplastids and dense protoplasm; and of a unicellular, strongly developed, glandular head, about 0.126 millimeter long and 0.054 in diameter, in which oil is found. The glandular oil-containing hair is easily distinguished from the one not containing oil by its terminal cell, which is slightly oblong-ovoid and is attached by one end to the basal cell; the cells of the basal portion of the hair are so arranged that the terminal cell forms an angle with the outer surface of the epidermis, frequently of 45° to 60°; and when the hair is in a depression the terminal cell may be parallel with the epidermis as shown in Plate 1, figs. 24*a* to 24*f* and 26, whereas in the hair not containing oil the terminal cell is very much elongated, about 0.3 to 0.4 millimeter long and 0.014 to 0.015 in diameter, and is more or less cylindrical. It is usually attached near one end to the basal cells in such a way that it forms a hair with unequal arms and is scythe-shaped, as represented in Plate 2, figs. 23*a* to 23*e*. The glandular oil-containing hair is distinguished further from the other type by the fact that the former is yellowish or greenish yellow, whereas the latter is colorless and transparent. Solereder (13) describes the two types of hair found in *Chenopodium ambrosioides* Linnæus as approaching a bladderlike type.

A comparative study of the number and distribution of the two kinds of hair, on cultivated plants which were well watered every day and on plants growing wild in a rather dry place, showed that the cultivated ones had fewer glandular hairs than had those in the dry places, and that in the cultivated plants the hairs were mostly confined to the lower side of the leaf and to the fruits, whereas on the wild plants glandular hairs were abundant on both sides of the leaf as well as on the fruits and young stems.

The flower.—The flowers of *Chenopodium ambrosioides* Linnæus are very minute; before opening they measure only from 0.5 to 0.8 millimeter in diameter. They are mostly perfect and regular, but some are unisexual. The perianth consists of a calyx only, green or sometimes reddish or purplish at the tip of the calyx lobes. These lobes of the calyx are united about halfway from the base, and the five yellow anthers protrude through the opening at the summit of the calyx, as indicated in

Plate 1, fig. 5. The bisexual flower is distinguished from the unisexual one even before opening by its larger size and more-regular shape; it is usually more or less spherical, with the calyx lobes somewhat elliptical in outline in dorsal view. The unisexual flower is smaller and somewhat irregular in shape, and the outline in dorsal view of the calyx lobes is ovate and slightly tapering at the tip. This difference is rather prominent in Plate 1, fig. 3, showing a unisexual flower, and in fig. 4, showing a bisexual flower, both at the stage before opening. An examination of the flowers at this stage showed many hairs scattered on the outer surface of the calyx and of the ovary. The two types of hair, the saclike and the scythe-shaped, are found on the dorsal surface of the calyx. Microchemical test reveals that the hairs of the first type contain oil, while those of the second do not. The upper half of the outer surface of the ovary is covered with a mass of only one kind of hair; namely, the glandular hair, which contains oil. Plate 1, fig. 8, represents a very young ovary dissected from a young flower; fig. 9 is of an older one taken from a flower just opened, about the same stage as in fig. 5; and fig. 10 is drawn from a young fruit. Evidently there are comparatively fewer glandular hairs in the younger stage than at the time when the flowers are opened. At this stage most of the glands are fully developed, and perhaps the amount of oil present in the hairs is greater than at the time the fruit is ripe. During the development of the embryo the calyx becomes irregularly thickened and gradually incloses the ovary. At this stage, as represented in Plate 1, fig. 10, most of the glandular hairs seem to have dried up or to be shrunken and collapsed. Whether this shrinkage of the hairs is simply due to evaporation, or to the pressure produced by the thickened calyx lobes that inclose it and by which some of the oil is squeezed from the glands and then evaporated, or to the condensation of the oil, or to intramolecular changes in the oil would be an interesting problem for investigation. Wirth,(16) who worked with *Chenopodium ambrosioides* var. *anthelminticum*, has the following to say in his paper:

> It would be an interesting experiment which might bring to light some important facts, to distill the oil from the plants in the flowering stage. Such an experiment would at least tend to show whether the cymene present in the oil distilled from the fruits was originally present, or was formed as a decomposition product of the ascaridol, upon the development of the fruit. There is, of course, the possibility that the oil in the flowers has higher ascaridol content than that distilled from the plant at a later stage. If this is true an important error lies in the

time of distillation; in fact, none of the work upon the distillation of plant products should be conducted without a previous knowledge of the changes in structure of the ovary, and constituents of the oil, until the time of maturity of the fruit.

The fruit.—For many years the fruit has been considered as the important part of the plant and the principal source of the oil of chenopodium. In fact, as indicated above, it was formerly classified as an official drug in the United States Pharmacopœia IX but was dropped from the edition of 1900. However, as the oil is prepared largely from the fruit, a more-critical investigation based upon a morphological, histological, and microchemical study seems to be of considerable interest. The fruit is more or less globular, with five distinct rounded ridges, of about the size of a pinhead, or a diameter of from 1 to 1.5 millimeters (Plate 1, fig. 6). When matured it is bright green or sometimes greenish yellow, and consists of a one-seeded utricle or achenelike fruit with thin, hyaline pericarp, and is loosely enveloped in a five-parted, irregularly thickened calyx. The fruits are generally arranged in clusters in spike panicles as illustrated in Plate 1, figs. 1 and 2, and when completely mature readily fall from the stalks. The calyx, which constitutes the fleshy part of the fruit, is persistent; and the five sepals, which are partially united in the flower and become united at the summit as well as along the margins during the development of the fruit, entirely inclose the pericarp, which closely adheres to the seed. When the calyx is young it is thin and the dorsal surface is somewhat smooth but bears some hairs; when it becomes older it gradually thickens and its dorsal surface is verrucose and most of the hairs disappear (Plate 1, fig. 6). A surface section of this region (Plate 2, fig. 24) shows that the cells are thin-walled, irregular, and more or less wavy in outline. They are smaller and less wavy than the epidermal cells of the leaf or those of the pericarp. Numerous stomata are present. The epidermal cells of the ventral side, however, do not have stomata, and are more wavy in outline and have thinner walls than those of the dorsal side. In a longitudinal section through the calyx, the epidermis of both dorsal and ventral sides consists of a single layer of cells, but the cells of the outer epidermis are slightly cutinized, larger, have thicker walls, and are less elongated than the cells of the inner or ventral epidermis, which are not cutinized. The mesophyll consists of two layers of palisade chlorenchyma or assimilatory tissue and ten to twelve rows of cells that are somewhat

elongated and have a more or less regular form; those toward the dorsal side are provided with some chloroplastids, while those toward the ventral side do not possess any, and many of them are practically filled with microcrystals of calcium oxalate. These are sometimes in rosette form. The individual crystals have a triangular or arrow shape and are very minute, less than 0.001 millimeter in length. Plate 2, fig. 25, represents two cells from the mesophyll with microcrystals of calcium oxalate. According to Molisch(8) the Chenopodiaceæ in general may contain, in addition to calcium oxalate, a solution of oxalates, which may be detected by precipitation with saturated alcoholic sodium hydroxide, saturated alcoholic potassium hydroxide, lead acetate, or barium chloride. A microchemical test, using these reagents, has shown that a solution of oxalate is present in *Chenopodium ambrosioides*. Plate 1, fig. 7, is a diagrammatic longitudinal section of a young fruit illustrating the more or less horizontal position of the seed, which is completely surrounded by the thin pericarp, the position of the grandular hairs, the distribution of the regions or area in which the microcrystals occur, and the two or three rows of spiral tracheary cells.

The pericarp.—The pericarp is very thin and hyaline and completely surrounds the seed. The parts can be studied better in the younger stages while the cells are turgid and the protoplasm is dense. It apparently consists of three layers of cells (Plate 2, fig. 16). According to Wirth,(16) however, in the var. *anthelminticum* the pericarp consists of two layers, an "epicarp" and an "endocarp," which resemble each other in size and outline. In *Chenopodium ambrosioides* Linnæus the outer and inner layers are separated by an incomplete layer of cells consisting of somewhat ovoid or rounded cells, between which are large intercellular spaces (Plate 2, fig. 16). When the pericarp becomes older the cell walls of the outer epidermis are thickened, and those of the inner epidermis and the cells between the two layers of epidermis collapse, so that eventually the pericarp appears very thin and as if composed of a single layer of cells. The lower part, however, near the base is much thicker and may consist of three or more layers of cells, and it is sometimes provided with tracheary cells. The cells of the outer and inner epidermis of the pericarp are very irregular and somewhat elongated and wavy in outline. Those near the base of the glandular hairs (Plate 2, fig. 18) have thicker walls

than do the others. The upper half of the pericarp bears a large mass of glandular hairs, and microchemical tests proved that all of these hairs contain oil.

The seed.—The position of the seed in the fruit, about which there are somewhat contradictory statements, is interesting. It is generally found in a horizontal position, or sometimes in a somewhat inclined position, and in a very few cases is erect or vertical. It is lentil-shaped, jet black and glistening when fully matured, and from 0.8 to 1 millimeter in diameter and from 0.3 to 0.6 in thickness. A median section of the seed shows that the embryo is coiled almost entirely around the endosperm. The seed coat consists of from two to four layers of cells. The outer layer, commonly known as the testa, is composed of a single layer of thick-walled cells, which are brown and are heavily cutinized. In a surface section these cells appear in rows in some places and in others they are irregularly arranged and have a somewhat wavy contour. The three inner layers which compose the tegmen are compressed and collapsed, have thinner walls, and are yellow. The endosperm is composed of parenchyma cells which are filled with spherical starch grains found in clusters. These starch grains are very minute, from 0.0008 to 0.001 millimeter in diameter (Plate 2, fig. 17). A microchemical test failed to show the presence of oil in the endosperm, but in the embryo oil was found to be rather abundant. Tincture of alkanet gives the best reaction, but immediate results are also obtained with the other reagent used. According to Wirth,(16) however, there is some fixed oil in the endosperm of the var. *anthelminticum*.

Structure of the leaf.—As pointed out by Solereder,(13) the leaf structure of the Chenopodiaceæ shows a great diversity of anatomical characters, and these characters were found to be correlated with the habitat of the members of the group. Variation was observed particularly in the mesophyll, which in many cases is differentiated into assimilatory and aqueous tissue. He described various interesting cases based on Volkens's investigations. The following are among the members of the Chenopodiaceæ that have been worked out and that showed variation:

Rhagodia billardieri R. Brown.
Bassia.
Kochia.
Chenolea.
Panderia.
Kirilowia.
Atriplex.
Halimus.
Traganum.
Halogeton.
Salsola.

The mesophyll of *Chenopodium ambrosioides*, however, seems not to show distinct variation. A cross section of the leaf of *Chenopodium ambrosioides* showed that it has no uniform thickness; in certain places depressions were observed (Plate 2, fig. 26). It is in these depressions that the glandular oil-containing hairs are located. The upper epidermis consists of a single layer of cells that have more or less undulated margins and are slightly cutinized (Plate 3, fig. 28). The lower epidermis also consists of a layer of cells, but with very much thinner walls than those in the upper epidermis and they are very much smaller (Plate 3, fig. 27). Palisade chlorenchyma is found on both sides of the leaf. The upper palisade chlorenchyma found just below the upper epidermis may consist of a single layer or of two layers of cells containing a large number of chloroplastids; some cells contain calcium oxalate crystals in rosette form. The upper palisade occupies almost half of the region. The cells of the lower palisade chlorenchyma are very much shorter and smaller than are those in the upper palisades, and they contain fewer chloroplastids. The region occupied by them is comparatively very much narrower. About one-third of the cross section of the mesophyll is occupied by the spongy chlorenchyma. The cells in this region are more or less rounded, but are sometimes elongated and irregular in shape. They are of two kinds, one containing a few chloroplastids, and the other none. Those of the latter kind are usually more elongated than are those containing chloroplastids, and are arranged in a single row. The veins are also surrounded by cells of this type, which are classified as aqueous tissue. The spongy cells are not very loosely arranged, and the air spaces between them are not very large. Stomata are present on both sides of the leaf, but they are more numerous on the lower surface. The hairs, both the saclike and the sickle-shaped or scythe-shaped, are mostly confined to the lower surface of the leaf, though occasionally they may be found also on the upper surface. If a finger is passed over the lower surface of the leaf the characteristic smell of the oil is detected; whereas, if it is passed over the upper surface, only a slight odor can be observed.

The midrib is rather characteristic in that the upper and lower parts contain no strongly developed collenchyma cells and the vascular tissue consists of from four to eight bundles or groups, arranged in the general form of a ring (Plate 3, fig. 27). Exterior of the phloëm there are one or two layers of

collenchyma almost surrounding the set of bundles. This anomalous position of the collenchyma cells is rarely observed in plant leaves. On the sides of the midrib there are two or more layers of chlorophyllous tissue or cells containing chlorophyll. Above, on both sides of the mibdrib, they extend from the palisade chlorenchyma to the collenchyma region, whereas below they reach from the spongy regions to the collenchyma. The last-named chlorophyllous cells seem to be a continuation of the lower palisade chlorenchyma, but in most cases they are polygonal. Surface views of the upper and lower epidermis of the blade are shown in Plate 3, figs. 28 and 29. The walls of the cells are less wavy than are the walls of the lower epidermis. Epidermal cells near the base of the glandular hairs are more or less elongated.

Structure of the stem.—A cróss section from the tip or the very young region reveals that the stem is elliptical or sometimes circular in outline with a wavy margin and with numerous hairs. The glandular hairs, those containing or secreting oil and those not containing oil, are abundant, particularly in the regions between the ridges, as demonstrated in Plate 3, figs. 30 and 31, drawn from the surface section made from the young and the old stems. The characteristic wavy outline of the cross section of the stem is due simply to the subepidermal bundles of collenchyma, which project as ribs. Between these collenchyma regions are palisade chlorenchyma, which consist of two layers of short cells filled with chloroplastids (Plate 3, fig. 32). In somewhat older parts of the stem cells of this type are also found, but in the section of a very old stem they are absent. The same is true of the glandular hairs.

The most peculiar characteristic of the structure of this plant is the anomalous development of the stem. The original cambium, which has been formed in the usual manner, soon ceases to function and a new cambium ring or arc of meristem arises from the pericycle and produces secondary bundles with accompanying medullary rays, as well as conjunctive tissue of varying structure. The xylem portion of these secondary vascular bundles develops on the inner, and the bast portions on the outer side of the meristem. After a certain period of development the process is repeated, and as a result of this repetition more or less concentric rings of wood and bast are

formed. As indicated by Solereder(13) this anomalous structure of the axis is a common characteristic of the other members of the Chenopodiaceæ, and occurs in the Nyctaginaceæ and Amaranthaceæ. Hérail(3) states, however, that this anomaly is not constant in the Chenopodiaceæ, for in his critical study on *Camphorosma monspeliaca*, he found that the structure of the plant is perfectly normal. According to Strasburger,(14) besides the three families mentioned, the Cycadaceæ, certain species of *Gnetum*, and the Phytolaccaceæ also exhibit extraordinary deviation in the development of secondary tissues.

The pericycle in the early stage of the stem, especially before the formation of the protoxylem or the primary vascular bundles, is not distinct. The cells of the stele have practically a homogenous characteristic, as shown in Plate 4, fig. 33, and some of them are filled with sand crystals of calcium oxalate. Soon the pericycle, which has the homogenous characteristic, becomes distinct, and groups of smaller cells appear interior to it, as illustrated in Plate 4, fig. 34. These groups of cells, which are rather long in the longitudinal section, give rise to vascular bundles. They have thin walls and divide actively. Those toward the center of the axis differentiate into protoxylem, and those toward the periphery into phloëm. The development of the protoxylem is evident in Plate 4, figs. 34 and 35. The cambium usually appears immediately after the protoxylem and phloëm regions have been established, and this cambium, formed between these two regions, is called fascicular cambium, or primary cambium. Its function is to give rise, when it divides, to xylem vessels toward the inner side, and phloëm cells toward the outer side, but it soon ceases its activity. The cells of the pericycle differentiate into meristematic tissue and develop secondary bundles with the accompanying medullary rays, as well as conjunctive tissue of varying structure. This is clearly shown in Plate 4, figs. 36 and 37, and Plate 5, fig. 38. After a certain period of development the secondary cambium ceases to develop or to give rise to wood toward the central axis and bast toward the periphery, and another cambium is formed from the pericycle, thus repeating the process. As a result of the various repetitions of the process concentric rings, or arcs, of wood and bast are formed. Sometimes, however, the pericycle cells around the stele do not all differentiate at the same time into meristematic tissue, so that the division

takes place in only one side of the stem; this is the reason why arcs of wood and bast are formed, and explains also the excentric position of the pith. Plate 5, fig. 39, drawn from a section of a rather old stem, shows the details of the wood and bast produced by the activities of the cambium derived from the pericycle; Plate 5, fig. 40, is a diagrammatic cross section from the stem of a plant that had grown in the garden of the University of the Philippines for about six months. It illustrates clearly the concentric rings and arcs of wood and bast, as well as the prosenchymatous conjunctive tissue. The woody part consists mostly of pitted vessels and wood fibers, and the prosenchymatous tissue of wood parenchyma. The sclerenchyma ring which is usually present in the pericycle of most dicotyledonous stems is not found in *Chenopodium ambrosioides* Linnæus, as the pericycle of this plant consists simply of thin-walled parenchyma cells, somewhat elongated, which are also pitted.

This extraordinary deviation from the usual type of secondary growth in stems is also distinctly observed in the root. In fact, the rings, or arcs, of wood and bast, with the accompanying medullary rays and prosenchymatous conjunctive tissue, are better developed and more distinct in the root than are those of the stem. Plate 5, fig. 41, is a diagrammatic cross section of the root of the same age as that of the stem shown in fig. 40.

SUMMARY AND CONCLUSIONS

1. Two distinct types of hair are found in *Chenopodium ambrosioides* Linnæus; namely, the saclike or bladderlike, and the scythe-shaped or sickle-shaped. Microchemical tests show that the saclike hairs contain oil, and the scythe-shaped do not (Plate 2, figs. 23*a* to 23*e* and 24*a* to 24*f*).

2. Both types of hair, the scythe-shaped and the saclike, are found in (*a*) both surfaces of the leaf, but more abundantly in the lower surface; (*b*) in the crevices or depressions between the ridges of the younger part of the stem; (*c*) on the outer surface of the calyx when the fruit is young; and (*d*) on the upper half of the ovary or fruit. The hairs on the latter are saclike only and all contain oil (Plate 2, fig. 26, and Plate 3, fig. 32).

3. In the mature fruit, the oil glands are mostly collapsed and consequently very little oil is left (Plate 1, fig. 10).

4. Some oil is found in the embryo but none in the endosperm.

5. Microcrystals of calcium oxalate (sometimes occurring in rosette form) are abundant in the leaves, stems, and calyx, especially in the younger stage of these parts of the plant. Solution of oxalates is also detected by microchemical test (Plate 2, figs. 25 and 26).

6. The flowers are mostly bisexual, but some are unisexual. The unisexual flowers consist of females only (Plate 1, figs. 3 to 5).

7. The perianth consists of the calyx only, which is persistent, smooth when young, and verrucose when older. Sections of the calyx show that the cells of the ventral and dorsal epidermis are very irregular in outline and that stomata are present in the dorsal epidermis. The mesophyll cells toward the ventral side contain many microcrystals of calcium oxalate (Plate 1, figs. 5 and 7; Plate 2, figs. 19 and 25).

8. The pericarp is thin and hyaline. It surrounds and adheres to the seed. On the upper part it bears a large number of oil-containing hairs. It consists of from two to three layers of cells and the lower part, near the base, of three or more layers of cells. The outer and inner epidermal cells are both thin-walled cells with wavy outline (Plate 1, figs. 7, 11, 12*a*, and 13*a*; Plate 2, figs. 16, 17, and 18).

9. The seed is generally in a horizontal position in the fruit, and in a few cases erect or vertical. It is lentil-shaped, jet black and glistening when mature, and from 0.8 to 1 millimeter in diameter, and from 0.3 to 0.6 millimeter in thickness. A section of it shows that the embryo is coiled almost completely around the endosperm. The testa is composed of a layer of cells with thick walls that are heavily cutinized and are dark brown; the tegment consists of two or three layers of thin-walled, deep yellow cells. The endosperm consists of parenchyma cells filled with small spherical starch grains grouped in clusters (Plate 1, figs. 7, 12*b*, 13*b*, and 14; Plate 2, figs. 16, 17, and 20).

10. The leaf is bifacial and thin, with glandular hairs and stomata on both sides. The upper and lower epidermal cells are very irregular in outline. The palisade chlorenchyma on the upper and lower sides may consist of one or two layers of cells, and the spongy chlorenchyma occupies a small region only (Plate 2, fig. 26; Plate 3, figs. 27, 28, and 29).

11. The midrib is provided with collenchyma cells below the upper and lower parts of the epidermis, and there are some on the peripheral side of the vascular bundles, which take the place of the sclerenchymatous tissue. The vascular bundles vary from four to eight (Plate 3, fig. 27).

12. The primary vascular tissues are developed by the fascicular cambium formed in the usual manner, but the secondary wood and bast are formed by the activity of the cells of the pericycle. This extraordinary deviation from the usual type of secondary growth in the stem is also observed in the root (Plate 3, figs. 30 to 32; Plate 4, figs. 33 to 37; Plate 5, figs. 38 to 41).

13. It is evident from the results of this investigation that the oil of chenopodium is confined largely to the glandular hairs of saclike shape, and that some is found in the embryo. The glandular hairs are especially abundant on both sides of the leaves, on the upper half of the ovary when this is nearly mature, in the crevices or depressions between the ridges of the young portion of the stem, and on the surface of the calyx. In order to get a greater yield of oil, therefore, the entire plant, except the old part of the stem, and before the fruits and leaves become too mature, should be used in distillation. The most favorable time to collect the plant is after most of the flowers are open.

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ILLUSTRATIONS

[All drawings by the author except figs. 1, 12*a*, 12*b*, 13*a*, and 13*b* of Plate 1, which were drawn by Macario Ligaya, of the Bureau of Science.]

PLATE 1. CHENOPODIUM AMBROSIOIDES LINNÆUS

FIG. 1. *a*, a habit sketch of a portion of the plant; *b*, a leaf taken from the lower part of the plant.

2. A cluster of flowers.

3. An unopened unisexual flower.

4. An unopened bisexual flower.

5. An open bisexual flower, showing the partially united calyx, ovary, glandular hairs, stigma, and stamens.

6. A fruit showing the verrucose characteristic of the calyx and some hairs not containing oil.

7. A diagrammatic longitudinal section of an unopened flower, showing transverse view of the seed; *r*, radicle; *co*, cotyledon; *en*, endosperm; *go*, glandular hairs containing oil; *p*, pericarp; *f*, filament; *ca*, regions occupied by microcrystals of calcium oxalate; *tr*, tracheæ.

8. A young ovary taken from an unopened flower, showing the young and the old glandular hairs containing oil, *go*, and the character of the stigma, *st*.

9. An ovary taken from an open flower, with numerous glandular hairs containing oil, *go*.

10. A young fruit with numerous shrunken or collapsed glandular hairs, *go*.

11. Oblique view from top of fruit, with the calyx removed, to show the distribution of glandular hairs.

12*a*. Top view of a fruit, with the calyx removed, showing the position of the glandular hairs.

12*b*. A view of the seed shown in fig. 12*a*, with the pericarp removed.

13*a*. Lateral view of a fruit, with the calyx removed, showing the glandular hairs and the position of the micropyle.

13*b*. Lateral view of the seed shown in fig. 13*a*, with the pericarp removed.

14. A semidiagrammatic longitudinal section of a seed showing position of embryo; *co*, cotyledon; *pl*, plumule; *r*, radicle; *en*, endosperm; *sc*, seed coats; *m*, micropyle.

PLATE 2. CHENOPODIUM AMBROSIOIDES LINNÆUS

FIG. 15. A semidiagrammatic drawing of a transverse section of a seed, showing: *sc*, seed coats; *en*, endosperm; *r*, radicle; *co*, cotyledon.

16. A portion of a transverse section of a young fruit showing: *go*, glandular hair; *p*, pericarp; *sc*, seed coats; *en*, endosperm.

FIG. 17. A portion of a transverse section of a mature fruit, showing: *go*, glandular hair; *p*, pericarp; *t*, testa; *tg*, tegment; *en*, endosperm cells filled with starch grains, *sg*.

18. Surface view of a portion of the pericarp, showing the wavy character of the cells and a glandular hair containing oil, *go*.

19. A longitudinal section of a calyx: *go*, glandular hair; *tr*, spiral tracheids; *ca*, microcrystals of calcium oxalate; *pal*, palisade chlorenchyma.

20. A portion of a surface view of the seed coat.

21. Surface view of the inner epidermis of the calyx.

22. Outer epidermis of the calyx.

23*a* to 23*e*. Different stages of glandular hairs not containing oil.

24*a* to 24*f*. Different stages of glandular hairs containing oil.

25. Two cells from the mesophyll of the calyx containing microcrystals of calcium oxalate.

26. A thin cross section of a leaf: *go*, glandular hair containing oil; *ca*, calcium oxalate in rosette form.

PLATE 3. CHENOPODIUM AMBROSIOIDES LINNÆUS

FIG. 27. Transverse section of the midrib, showing: *col*, collenchyma; *vb*, vascular bundle; *chl*, chlorophyllous tissue; *go*, glandular hair containing oil; *go'*, glandular hair not containing oil.

28. A surface view of the upper epidermis of a leaf with a glandular hair containing oil.

29. A surface view of the lower epidermis of a leaf.

30. A surface view of an epidermis taken from the depression between the ridges of the young stem, showing glandular hairs containing oil and some not containing oil.

31. Surface view of the epidermis taken between the ridges of the old stem.

32. A diagrammatic cross section of a young stem, showing the distribution of: *go*, glandular hair containing oil; *go'*, glandular hair not containing oil; *pal*, palisade chlorenchyma; *col*, collenchyma region; *per*, pericycle; *vb*, vascular bundle.

PLATE 4. CHENOPODIUM AMBROSIOIDES LINNÆUS

FIG. 33. A portion of a transverse section of a very young stem, showing the very young glandular hair and the undifferentiated tissue and sand crystals of calcium oxalate.

34. A portion of a cross section of an older stem, showing the differentiation of the cells within the pericycle into protoxylem, phloëm, and fascicular cambium.

35. A young vascular bundle from a transverse section of the stem, showing the protoxylem, x_1; fascicular cambium, *fc*; and phloëm, *ph*.

36. A single vascular bundle from a cross section of an older stem, showing the primary xylem, x_1; fascicular cambium, *fc*; phloëm, *ph*; and the pericycle differentiating into meristematic tissue.

37. A portion of a transverse section of an old stem, showing the primary xylem, x_1; and the secondary xylem, x_2, formed by the meristematic tissue of the pericycle.

PLATE 5. CHENOPODIUM AMBROSIOIDES LINNÆUS

FIG. 38. A section from an older stem, showing the development of secondary wood.

39. A small portion of a transverse section of a very old stem, showing the rings or arcs of wood alternating with the bast formed by the activities of the pericycle cells.

40. A diagrammatic cross section of the stem showing the rings or arcs of wood and bast developed from the meristematic tissue of the pericycle: *w*, wood; *b*, bast; *cor*, cortex; x_1, primary xylem.

41. A diagrammatic cross section of an old primary root, showing the rings or arcs of wood and bast formed by the activities of the pericycle: *cor*, cortex; *w*, wood; *b*, bast; x_1, primary xylem.

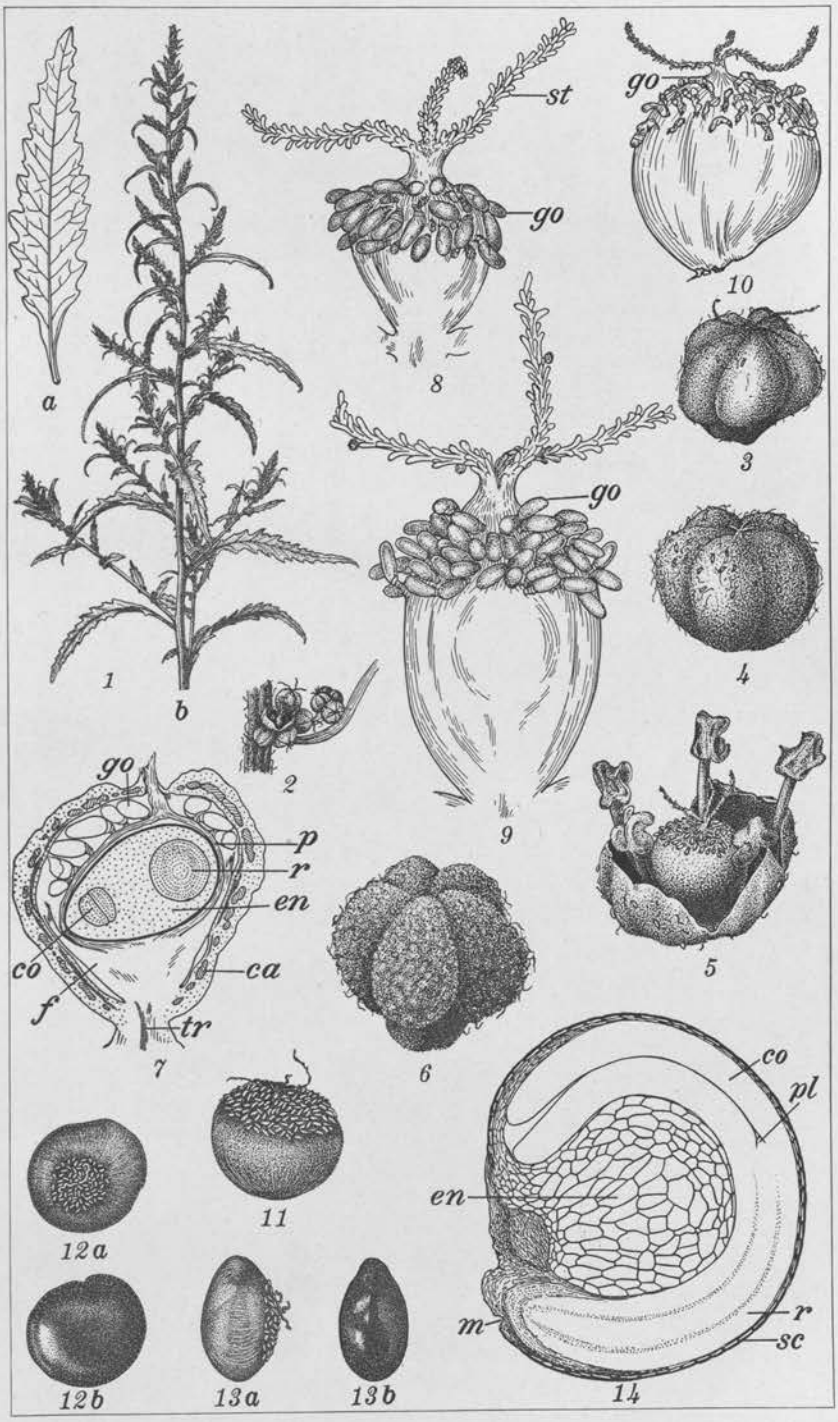
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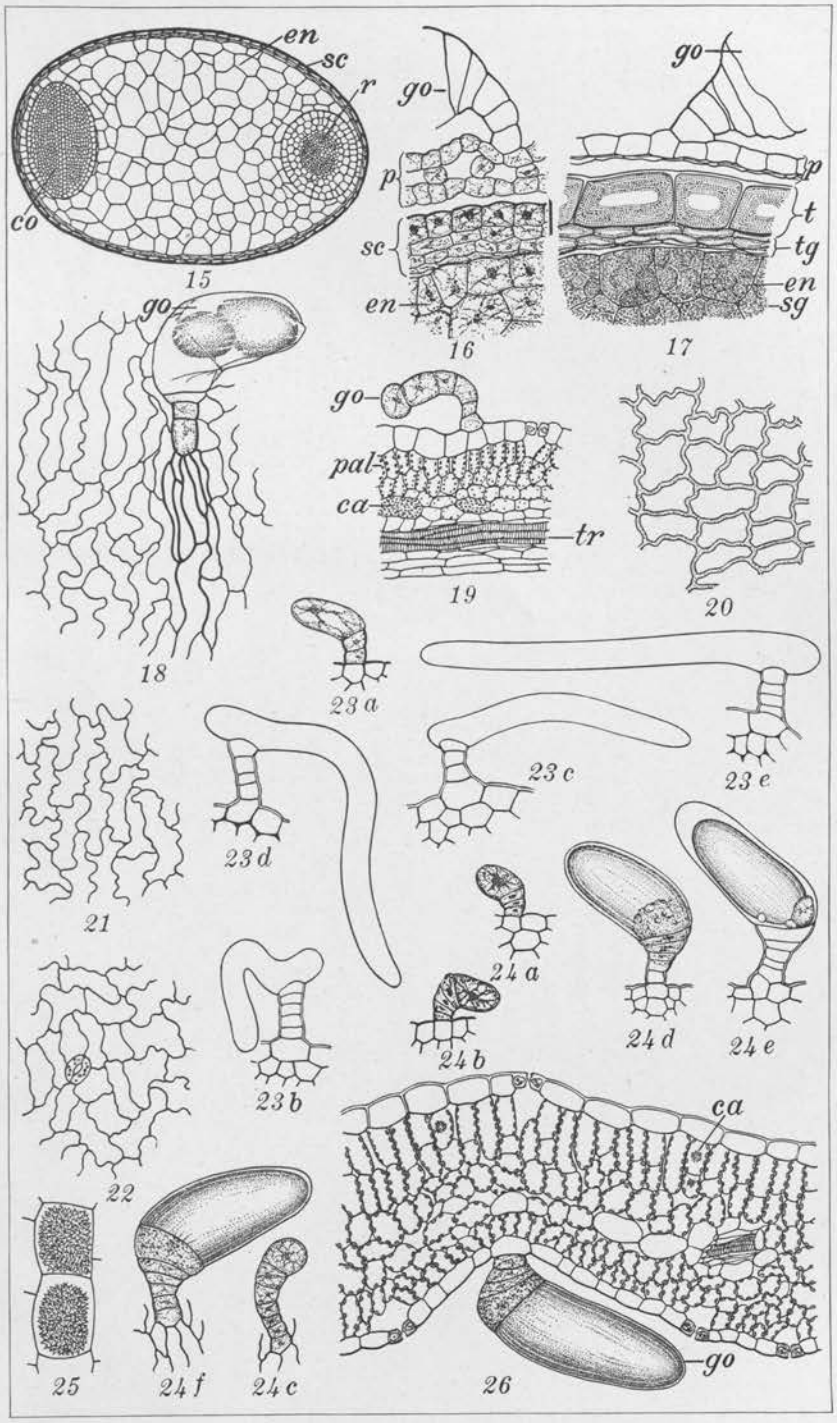
PLATE 1.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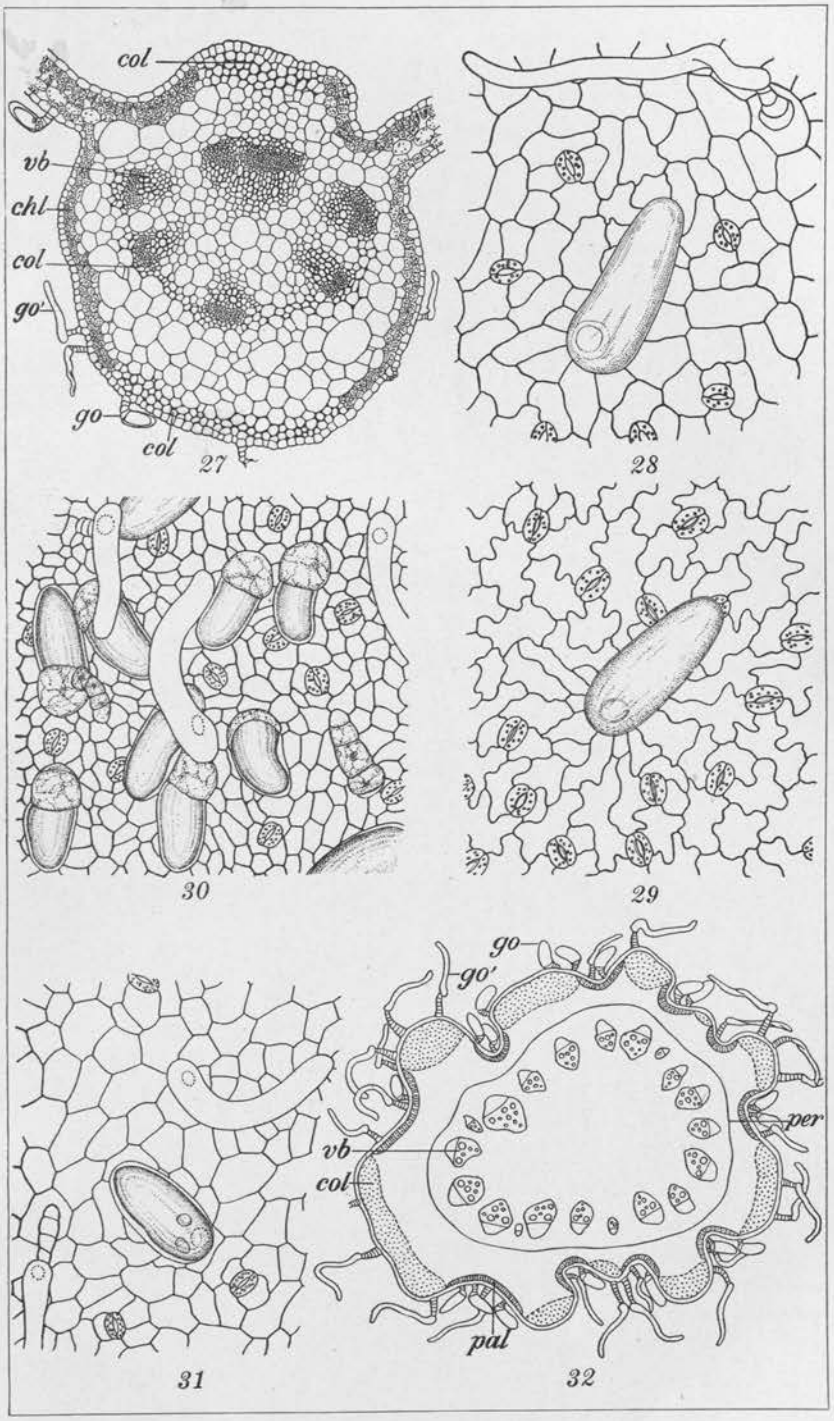

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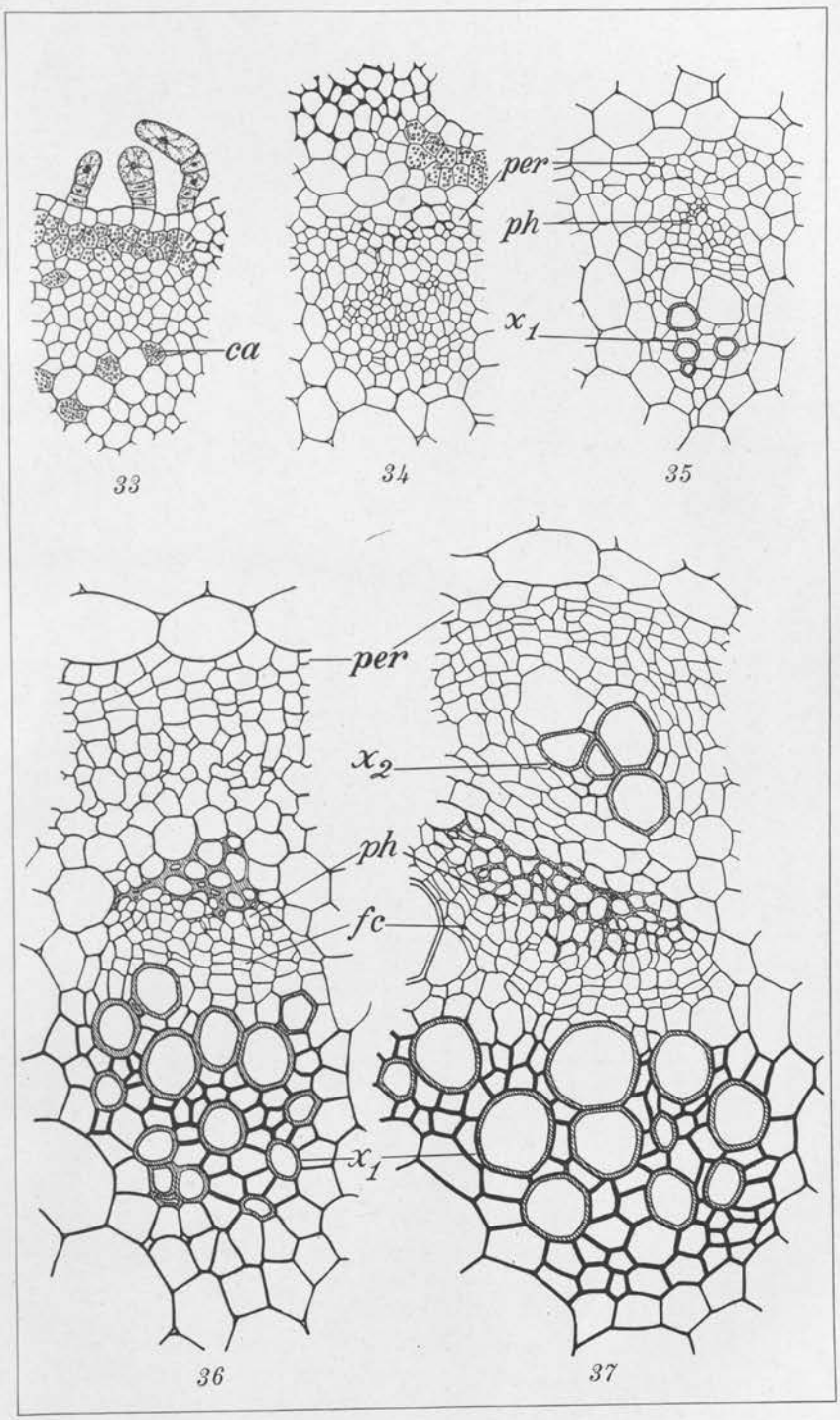

PLATE 4.

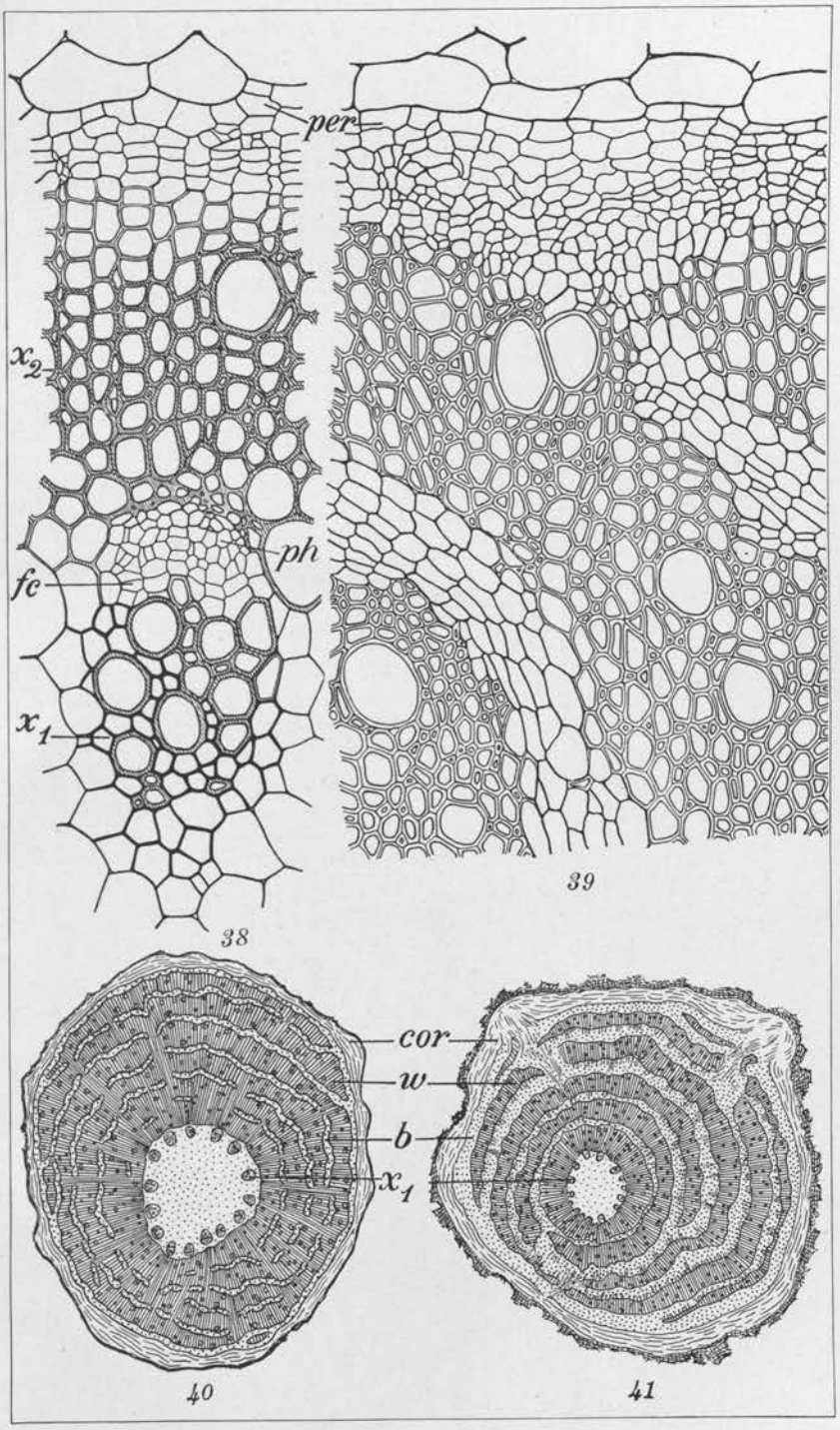

PLATE 5.

STRUCTURAL CHARACTERISTICS OF DOUBLE-YOLKED EGGS AND THE RELATION OF THE MEMBRANES OF TWIN EMBRYOS RESULTING FROM A DOUBLE-YOLKED EGG

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ONE PLATE AND TWO TEXT FIGURES

The types of abnormal eggs produced by domestic fowls are: dwarf eggs, double- and triple-yolked eggs, and inclosed eggs (ovum in ovo). Although the double-yolked eggs are commoner than the other types, their occurrence is rare enough to warrant the report of additional data. The only report on an abnormal egg of this type in the Philippines, so far as I know, is that by Fronda.(4) The primary object of the following account is to describe four such eggs that have come under my direct observation during the last four years, and to report some observations on the disposition of the twin embryos and their membranes developing from a double-yolked egg. The features presented by the specimens here described, though some of them resembled those of the double-yolked eggs previously reported, will be of interest to naturalists as well as to those who are interested in raising poultry.

Our knowledge of the origin and production of double-yolked eggs is very incomplete; the various accounts on the subject appear to be not only contradictory but more or less speculative. Evidently the reason for this is that there is no way whereby the sequence of stages that an ovum undergoes, during the process of development within the bird's body, can be observed and timed. Parker(7) advanced the hypothesis that double-yolked eggs are due to the "simultaneous or almost simultaneous" liberation of two ova either from one or from two separate follicles; the ova proceed through the oviduct together, where they are both incorporated in a common set of egg membranes in an essentially normal manner. Glasser,(5) on the other hand, is of the opinion that there is no need of simultaneous discharge

of two ova for the production of a double-yolked egg, in as much as the first ovum discharged may be delayed in the infundibulum until it is overtaken by another ovum resulting from the next ovulation. His findings, in the study of an abnormal ovary of a hen that habitually laid double-yolked eggs, led him to formulate the conclusion that, in this particular case at least, they were the result of the rupture of compound follicles resulting from secondary fusion. This conclusion was based upon the fact that, according to his observations, secondary fusion of follicles resulted in the establishment of a common blood supply for both ova, which, being in the same state of permeability, underwent equivalent growth and became liberated at the same time.

Curtis(2, 3) in his study of the relation of the egg envelopes, made on 131 double-yolked eggs, found only 21, or 16.03 per cent, that showed evidence of simultaneous ovulation. He considered the double-yolked eggs inclosed in a complete set of common egg envelopes as cases giving good reason for suspecting simultaneous ovulation. The various kinds of evidence obtained in his studies led him to conclude that simultaneous ovulation can hardly account for the production of double-yolked eggs; that the conditions necessary for their formation are that the two yolks furnished by two consecutive ovulations unite in the oviduct and then pass down the duct together, their union occurring "indiscriminately at all levels of the oviduct." As possible causes for the presence of two yolks in the duct at the same time, he suggests the following:

That double-yolked eggs sometimes represent a heightened rate of fecundity;

That the first egg may sometimes come to a place in the oviduct which is subnormally sensitive to peristaltic stimuli, and remain there until joined by the second yolk;

That the second yolk may pass through the duct at an abnormally rapid rate;

That antiperistaltic movements may carry the first egg back up the duct until it meets the second;

That either the first or the second yolk to enter the duct was ovulated into the body cavity and was taken up by the duct shortly before or immediately after the next ovulation.

DESCRIPTION OF THE EGGS

Egg 1 used in this study came from the department of animal husbandry, College of Agriculture. It was one of two dozen hen's eggs requisitioned some time in the first semester of the

school year (1921–1922) for the class in embryology. While I was putting the eggs in the incubator the unusual shape and length of this egg attracted my attention. The egg was found to be 62 millimeters long and 41 broad, and to weigh 66.4 grams.

The poles were almost equally blunt, the point being hardly distinguishable from the butt. The shell was brownish and perfectly smooth except at a point equidistant from the poles, where there was a rather rough, granular, and somewhat depressed band about 7 millimeters in width encircling the egg. The band was indicated internally by a low rounded ridge. The egg was left in the incubator overnight. When the egg was opened next morning the anomalous internal condition, consisting of the presence of two distinct yolks inclosed in a common shell membrane, was revealed.

The yolk lying toward the point was apparently normal in form and size. On its surface was a very conspicuous blastoderm with an apparently normal developing embryo at primitive-streak stage. The long axis of the embryo formed almost a right angle with that of the egg. The yolk nearer the butt was rather crescentic in form, having its convex surface directed toward the air chamber and its concave surface loosely applied to the other yolk. Its color was somewhat paler than that of the other yolk, and it showed no developing embryo. Its germinal disk was very indistinct.

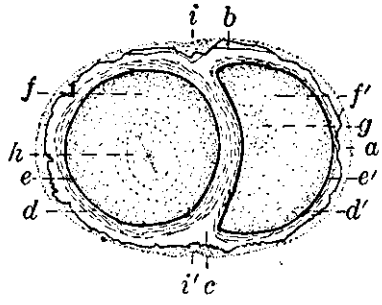

FIG. 1. Schematic drawing of double-yolked egg 1, showing the relation of its various parts. *a*, shell; *b*, shell membrane; *c*, albumen; *d*, *d′*, chalazal membranes; *e*, *e′*, vitelline membranes; *f*, *f′*, yolks; *g*, germinal disk; *h*, blastoderm; and *i*, *i′*, depression around the external surface of the shell.

The shell membrane presented no special features. The albumen was not only thick but also rather viscid in consistency. There appeared to be more than is usual for a single normal egg. In order to determine the character and arrangement of the other egg membranes, the contents of the egg were carefully poured into a beaker containing 20 per cent formalin. After shaking the beaker a little it was noted that the two yolks separated very easily, and that each yolk possessed distinct and independent chalazal and vitelline membranes. However, the chalazal membrane of the yolk nearer the butt was thinner than that of the other. There was no evidence of the presence of

chalaza extending to the broad end of the egg. A drawing of the egg showing the relation of its various structures is shown in fig. 1.

Egg 1 somewhat resembled one of the eggs reported by Parker.(7) It was a very good example of Type II of Curtis's classification(3) (double-yolked eggs having separate chalaziferous layers but all or part of the thick albumen common to two yolks). The difference in thickness of the chalazal membranes of the two component yolks and the presence of a circular depression on the external surface of the shell make the explanation of the possible point of their union difficult. Probably the yolks came together in the infundibulum where most of the chalazal membrane is secreted, and their union occurred after the first yolk had been there long enough to acquire the thick chalazal membrane. On arrival of the second yolk in its vicinity active peristalsis set in, which drove the two yolks together down the oviduct. Thus, the second yolk could not stay in the funnel long enough to be surrounded by a chalazal membrane as thick as that of the first. This may account also for its being infertile. Another possibility is that the second yolk may have traversed the funnel at an abnormally rapid rate, so that a very thin chalazal membrane was formed before it joined the first yolk in the albumen-secreting portion. Curtis(2) is of the opinion that the ova of double-yolked eggs, having a depression around the center of the external surface of the shell, join while passing into the isthmus. In Egg 1 the crescentic form of the yolk nearer the butt may have been due to the pressure the thick albumen exerted upon it; its chalazal membrane, being thinner and weaker than that of the other yolk, must have been pressed tightly against it.

Egg 2 was one of eight hen's eggs bought for domestic use in June, 1923, from an unknown egg dealer at the market in Los Baños, Laguna Province, Luzon. Its unusually large size led me to suspect that it was a case of either double- or triple-yolked egg. So it was taken to the laboratory for a thorough examination.

The shell was white and perfectly smooth throughout. As to shape it showed nothing unusual, the point, as in normal eggs, being markedly distinguishable from the butt. It was 58 millimeters long and 44 broad, and weighed 64.5 grams. When the egg was opened the presence of two yolks, inclosed in a normal shell membrane and a common mass of albumen, was disclosed. One yolk was located toward the point, and the other toward the

butt. They both appeared perfectly normal in form and color, and were apparently of the same size and age. Each yolk appeared to be normal for a single normal egg and showed a very distinct germinal disk. At their points of contact they were slightly flattened. The albumen was rather thick; otherwise it was perfectly normal for a single egg. When the contents of the egg were placed in 20 per cent formalin, it was noted that the yolks would not separate until the chalazal membrane was torn off. The removal of the latter proved that the yolks possessed distinct and separate vitelline membranes. The relations of the egg's various parts are shown in fig. 2.

Egg 3 was one of five duck's eggs bought in the Los Baños market on October 16, 1924, as embryological material. This egg was very much larger than the other four; it measured 74 millimeters in length and 50 in breadth. Its weight was 105.7 grams. The mean dimensions of the other four eggs were: length, 59.5 millimeters, and breadth, 44.5; the mean weight was 67.1 grams. The shape of egg 3 was normal, and the shell was white and uniformly smooth throughout. About 30 millimeters from the broad end, or butt, there was a very shallow transverse depression about 8 millimeters in width extending over one-fifth of the entire circumference of the egg. The shell seemed to be unusually thin, and in the vicinity of its narrow end, or point, it was almost transparent, so that the outline of a yolk within could be traced.

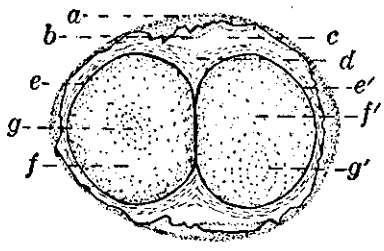

FIG. 2. Schematic drawing of double-yolked egg 2, showing the relation of its various structures. *a*, shell; *b*, shell membrane; *c*, albumen; *d*, chalazal membrane; *e*, *e'*, vitelline membranes; *f*, *f'*, yolks; and *g*, *g'*, germinal disks.

When the egg was opened, it was observed that the arrangement of its contents was practically identical to that noted in egg 2. There were two distinct yolks inclosed in a common shell membrane, chalazal membrane, and a thick layer of albumen. Their points of contact were not so flattened as in egg 2, but the two vitelline membranes adhered so closely at their points of contact that the two yolks did not separate when placed in 20 per cent formalin. Each yolk showed a very distinct and apparently normal germinal disk. The yolk lying nearer the point was found to be firmly attached to the shell membrane by a short but rather thick chalaza. The chalaza extending

from the yolk lying nearer the butt was deflected toward one side instead of pointing toward the air chamber.

Eggs 2 and 3 undoubtedly fall under Type II of Curtis's classification (3) (double-yolked eggs having the entire set of egg envelopes common to two yolks). The arrangement of the parts of each egg very clearly showed that the two yolks had traversed the entire length of the oviduct together. The question as to whether eggs of this type are due to simultaneous ovulation or to the union of the two ova in the infundibulum, where they become incorporated in a common chalazal membrane before they pass down the rest of the oviduct, needs further evidence and elucidation before it can be answered. Curtis (3) states that eggs of this type give the best evidence of simultaneous ovulation, but unfortunately the various kinds of evidence he obtained in his observations led him to doubt the occurrence of such phenomena. He is inclined to conclude that the origin of double-yolked eggs having the entire set of egg envelopes common to two yolks is due to a heightened rate of fecundity in which there is an abnormally short interval between two consecutive ovulations.

Egg 4 was also a duck's egg bought for domestic use from an unknown person from the barrio of Mayondon, Los Baños, on November 13, 1924. Except for its very large size, externally, it presented nothing unusual, the point and butt being sufficiently distinguishable, and the shell shiny and smooth throughout. The color was almost white. It was 74 millimeters long and 53 broad, and weighed 99.8 grams.

Under the supposition that this was an egg with more than one yolk, it was incubated under the care of Doctor Fronda, poultry division, College of Agriculture, for eighteen days (November 14 to December 2, 1924) for the purpose of getting some information as to the relative position of the developing embryos within a common shell and the nature and arrangement of their embryonic membranes. The ordinary laboratory method of opening eggs was followed; namely, an elliptical piece of the shell was removed, great care having been taken not to rupture the underlying shell membrane. When the exposed shell membrane was cut and deflected toward one side, the presence of two duck embryos covered with black feathers and inclosed in a common shell membrane was revealed. Both were living and appeared to be in the same stage of development. They were lying side by side in reverse positions, the right side of the embryo nearer the butt directed toward the air chamber, and that

of the other embryo toward the point. Their long axes were apparently parallel, but they were oblique to the major axis of the whole egg. In all probability this relation of the embryonic axes and the long axis of the egg was the result of the embryos beginning to accommodate themselves to the form of the egg so as to lie parallel to its long axis. According to Lillie(6) and Bartelmez(1) in the majority of the cases, if an egg be placed with the blunt end to the left, the head of the embryo will be found directed away from the observer when the blastoderm is above. In egg 4 this assertion finds support only in the embryo lying nearer the narrow end, or point, of the egg.

The embryos were slightly different in size, and their weights were as follows:

	Grams.
Embryo lying nearer the point:	
With the yolk sac	35.5
Without the yolk sac	15.0
Embryo lying nearer the butt:	
With the yolk sac	41.0
Without the yolk sac	20.0

In spite of this difference in size both appeared normal in development for normal duck embryos of eighteen days' incubation. They were surrounded by a common chorion and a common allantoic cavity, but were provided with separate amnion and yolk sac. The possession by each embryo of an independent and apparently normal allantoic stalk and the very apparent anastomosis of the blood vessels of the outer walls of the allantois indicate conclusively that the embryos did develop separate chorion and allantois which later fused about the region of the equator. In most part the inner wall of the allantois was already inseparable from the corresponding amnion. Stretched between the two embryos was a very vascular membrane formed by the union of the apposed parts of the inner wall of the allantois. The membrane had no attachment to the shell membrane, and was very much folded in the neighborhood of the lower pole of the yolk sacs. Together with the chorion, it almost completely surrounded a very viscid mass of albumen that had accumulated around the two yolk-sac umbilici. The latter were in direct apposition, but not fused together.

From the data furnished by the embryos and their membranes, it can be safely concluded that it was a case of a double-yolked egg, the two separate ova both being fertilized. The question, under which type of Curtis's classification(3) should this egg fall, cannot be answered here, for the embryos had already reached

such a degree of development that study of the relation of the yolks to the albumen and chalazal membrane was impossible. The photographs of the twin duck embryos, with parts of their accessory appendages, are shown in Plate 1.

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ILLUSTRATIONS

PLATE 1

FIG. 1. Showing the relation of the twin embryos in situ. *a*, shell; *b*,*b'*, yolk-sacs; *c*, air-chamber; *d*, amnion; *e*,*e'*, embryos; *f*, shell membrane with the attached chorion and outer wall of the allantois.

2. Showing the two distinct duct embryos together with parts of their accessory appendages. *a*, hardened albumen (due to formalin) found surrounding the yolk-sac umbilici; *b*, yolk-sac umbilicus; *c*, internal surface of the shell showing the anastomoses of the blood vessels in the outer wall of the allantois.

TEXT FIGURES

FIG. 1. Schematic drawing of double-yolked egg 1, showing the relation of its various parts. *a*, shell; *b*, shell membrane; *c*, albumen; *d*,*d'*, chalazal membranes; *e*,*e'*, vitelline membranes; *f*,*f'*, yolks; *g*, germinal disk; *h*, blastoderm; and *i*,*i'*, depression around the external surface of the shell.

2. Schematic drawing of double-yolked egg 2, showing the relation of its various structures. *a*, shell; *b*, shell membrane; *c*, albumen; *d*, chalazal membrane; *e*,*e'*, vitelline membranes; *f*,*f'*, yolks; and *g*,*g'*, germinal disks.

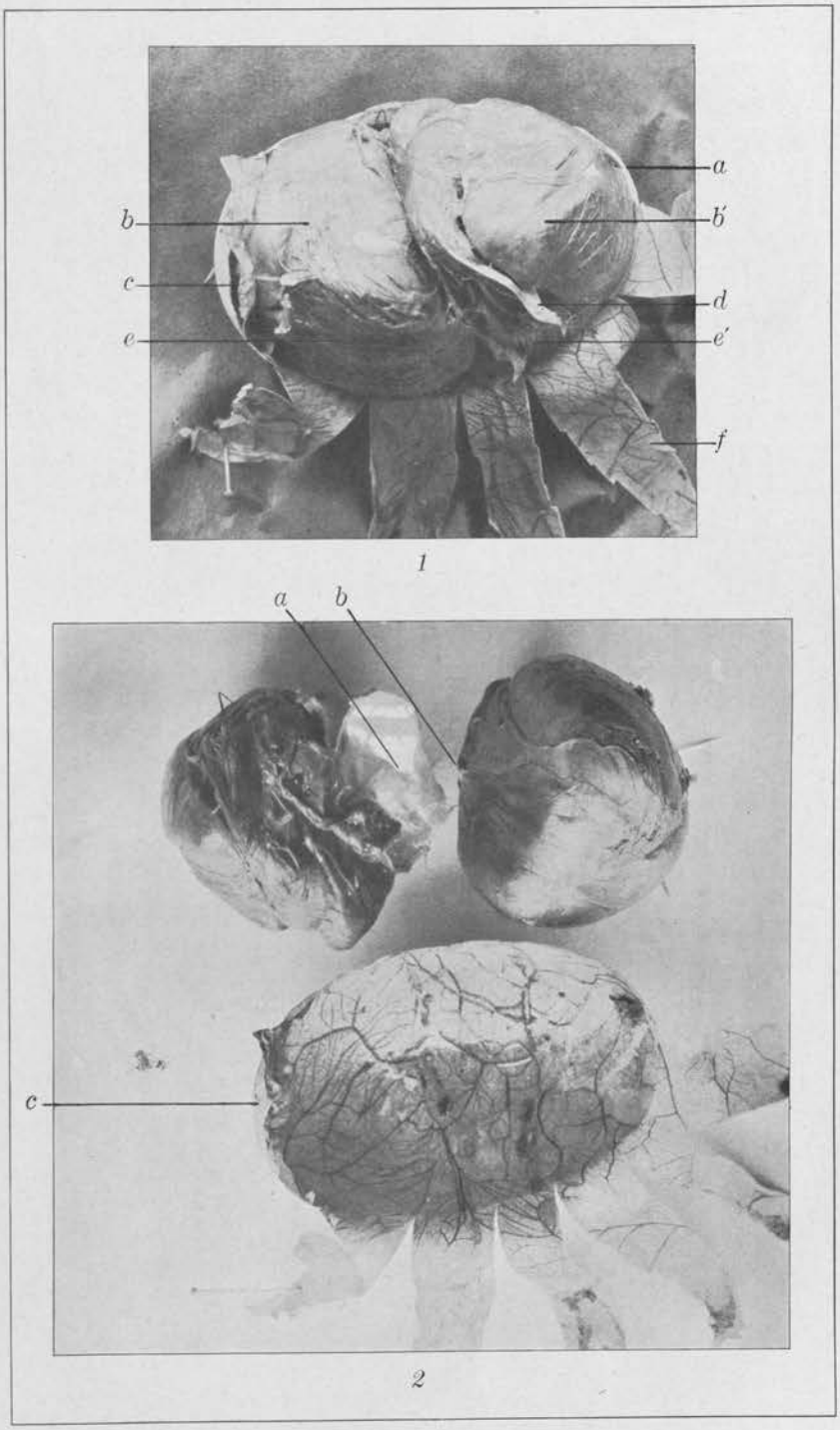


PLATE 1. CONTENTS OF A DOUBLE-YOLKED EGG.

TWO NEW SPECIES OF DRAGON FLIES (ODONATA) FROM THE PHILIPPINE ISLANDS, WITH REMARKS ON THE GENUS HELIOGOMPHUS

By F. F. LAIDLAW

Corresponding Member of the Malayan Branch, Royal Asiatic Society

THREE TEXT FIGURES

ANISOPTERA

GOMPHIDÆ

Genus **HELIOGOMPHUS** Laidlaw

Genotype *H. nietneri* (de Selys).

A gomphine genus with the following characters:

1. Triangles, supratriangles, and subtriangles uncrossed.
2. Triangles regular in shape (that is, sides definitely rectilinear).
3. Triangles of forewing rather shorter than those of hind wing.
4. No trigonal supplement.
5. No well-developed supplementary sector to Rs or to M_4.
6. Cross veins between M_{1+3} and M_4 show no indication of being spaced out.
7. Pterostigma feebly braced or not at all.
8. No basal postcostal nerve.
9. No "anal loop" on hind wing.
10. Sectors of arculus at first converging, then diverging.
11. Cells between Cu_2 and anal margin not arranged pectinately.
12. Cu_1 reaches margin of forewing a little beyond level of nodus.
13. Segment 9 of abdomen shorter than segment 8.

Characters 1 to 7 especially indicate the position of *Heliogomphus* in a series of genera called by Williamson the series "Epigomphus," but it may be remarked that two Oriental genera, which I refer at present to this series, show a distinct tendency to a spacing out of the cross veins between M_{1+3} and M_4, and therefore differ from *Heliogomphus*, as from other genera of the series, in respect to character 6. As in other genera, the legs in *Heliogomphus* are relatively short, the hindmost femora when adpressed reaching to the apex of the first segment of the abdomen.

Heliogomphus is distinguished from other Oriental genera of the Epigomphus series by characters as follows:

Perissogomphus, 6, 9, 10, 11.
Macrogomphus, 8, 10, 11, 14.
Acrogomphus, 6, 7, 9, 11.
Leptogomphus, 8, 10.
Microgomphus, 12.

Certain secondary sexual characters also differentiate the males of *Heliogomphus* readily from those belonging to allied genera. Of these the most striking are the lyrate upper anal appendages, which as a rule have their apices white or yellow, contrasting with the black bases. These differ greatly in appearance from the chelate appendages of *Microgomphus*.

Equally important is the large size of the vesicle of the penis and the relatively small size of the hamuli, characters first pointed out by Ris. *Microgomphus* shows a similar condition, whilst in *Leptogomphus* the converse obtains.

It is evident that *Heliogomphus* and *Microgomphus* are closely allied, and the discovery of intermediate forms is possible. At present one can add size to the few characters that separate them. The known species of *Microgomphus* are distinctly smaller than any known *Heliogomphus* species. Their coloring also is more variegated. It is not unlikely that larval characters may help to differentiate the two.

The following are the described species referable to *Heliogomphus:*

Heliogomphus nietneri (de Selys), Ceylon and Assam.
Heliogomphus pruinans Fraser, South India.
Heliogomphus spirillum Fraser, Assam.
Heliogomphus retroflexus (Ris), Tonkin.
Heliogomphus scorpio (Ris), South China.
Heliogomphus kelantanensis (Laidlaw), Malay Peninsula.

To these I now add one new species.

Heliogomphus bakeri sp. nov. Text fig. 1.

LUZON, Laguna Province, Mount Maquiling (*C. F. Baker*), one male, autotype.

Length of abdomen, 38 millimeters + 1.25; of hind wing, 35.

Head, upper lip dull yellow, finely margined with black, and with a fine, median line of black bisecting it. Genæ and frons also yellow. Clypeus, vertex, and occiput black.

Prothorax black, its anterior lobe and a pair of spots on either side of the middle lobe yellow.

Synthorax, dorsum black, mesothoracic collar yellow, narrowly interrupted in the middle line; joined on either side by the anterior end of the dorsal bands, which form with the collar ∠\-shaped marks, and are pointed at their upper ends near the antealar sinus. To the outer side of each, and near the upper end lies a small triangular mark of yellow, the vestige of an antehumeral band. Sides yellow, with a black line along the position of each of the lateral sutures. Ventral surfaces yellow. Legs entirely black excepting the coxæ which are yellow.

Abdomen, segments 1, 2, 8, and 9 moderately inflated. Ground color black, smooth, rather shining. Brownish yellow marks on the sides of the first and second segments, auricles of the same color. Small basal lateral marks of orange on segments 3 to 6. Segment 7 with square orange mark on the dorsum, occupying its basal quarter. A small, basal, triangular mark of the same color on the dorsum of segment 8, and paired apical marks of a paler yellow on the sides of the same segment.

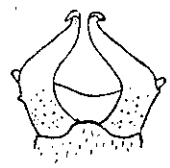


FIG. 1. *Heliogomphus bakeri* sp. nov.; male, anal appendages, dorsal view.

Anal appendages black, the upper ones shading to pale yellow apically. The upper appendages are lyrate, each with a very small extero-lateral projection at the point at which they begin to curve inward, and with their apices curved upward. Lower appendage with widely divaricated branches, about half the length of the upper.

Forewing with a single row of cells between Cu_2 and the anal margin of the wing (on the forewing two cells for the space of a single cell). Two cross nerves in the cubital space; 16 antenodal, 15 or 16 postnodal cross nerves.

Hind wing with at first 2, then 3 rows of cells between Cu_2 and the anal margin of the wing. One cross nerve in cubital space; 11 antenodal and 14 or 15 postnodal cross nerves.

Heliogomphus bakeri differs from *H. kelantanensis* (as I believe do all the other described species of the genus) in that M_4 and Cu_1 are not parallel as far as the level of the nodus in the front wing. It differs from all the remaining species except *scorpio* in that the dorsal stripes of the synthorax join the mesothoracic collar (as also in *kelantanensis*); *bakeri* further agrees with *scorpio* in having two cross nerves in the cubital space of the forewing, and in this respect these two species differ from the other species of the genus. Lastly, *scorpio* has two rows of cells between Cu_2 and the anal margin of the fore-

wing, whilst the anal appendages of the male are much bolder in outline, and each of the upper appendages carries a very large knoblike extero-lateral process.

ZYGOPTERA

PLATYCNEMINÆ

Coeliccia dinoceras sp. nov. Text figs. 2, 3.

MINDANAO, Lanao Province, Kolambugan, May 18, 1914 (*E. A. Wileman*). In my collection. One male, autotype.

Length of hind wing, 25 millimeters, of abdomen 35 + 1.25 (anal appendages).

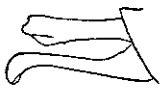


FIG. 2. *Coeliccia dinoceras* sp. nov.; male, anal appendages, lateral view.

Head, generally dull black, upper lip black, rather metallic. Genæ and anteclypeus blue, oval-oblong postocular spots of the same color, small and lying transversely. Basal joint of antennæ white; a transverse blue mark on either side of posterior ocelli. Dorsal surface of prothorax black, with a large, nearly circular spot on the middle lobe on either side of the middle line probably blue during life, but faded to a dirty yellow in the dried specimen. Posterior margin of prothorax armed with a pair of relatively large spines, one on either side. These project upward and are sharply curved forward toward their extremities. Ventrally the coloring of the prothorax fades to a dull yellow.

FIG. 3. *Coeliccia dinoceras* sp. nov.; male, prothorax, lateral view, showing prothoracic horns.

Synthorax, dorsum black, the black just passing the humeral suture laterally. A pair of blue (?) dorsal bands, narrow and tapering toward their upper extremities. To the outer side of each of these, and close to the antealar sinus is a minute triangular spot of the same color as the bands. Sides blue (?) with a narrow line of black along the second lateral suture. Legs yellow, with a narrow line of black along the posterior surface of the femora.

Abdomen long and very slender, segments 7, 8, and 9 progressively a little stouter than the others. Coloring generally a dull brownish yellow anteriorly, paler beneath, passing gradually to dull black on the hinder segments (6 to 10). The first segment is probably pale blue in life, with a narrow, longitudinal band of black middorsally. The second segment and base of the third have paler

markings at the sides which also are probably blue in the living insect. The appearance of the distal third of the eighth segment dorsally, and of the whole dorsum of 9 and 10 suggests that these, too, are blue.

Anal appendages black. Both pairs are long and slender, the lower pair decidedly longer than the upper pair, the latter rather club-shaped with bluntly pointed apices. Lower pair cylindrical, hooked downward a little at their apices.

Venation, wings petiolated to level of Ac. Pterostigma small, slightly inflated, black, covering one cell. M_3 rises from subnodal vein, Rs well distal to it. Quadrangle of forewing with costal margin about three-fifths length of anal margin; of hind wing about four-fifths. Three cells between distal end of quadrangle and subnodal cross vein; 16 or 17 postnodal cross nerves on forewing, 15 on hind wing.

This species, the first of the genus to be recorded from the Philippine Islands, is distinguished at once from other known species of the genus by the remarkable armature of the prothorax. It is the only species in which the male carries any such ornament. The anal appendages likewise are rather characteristic. Venationally the species comes near to a group of Bornean species (*C. macrostigma* Laidlaw, *C. campioni* Laidlaw, etc.). These are all remarkable for the specialization of the female prothorax, and it will be interesting to see whether the female specimen of *dinoceras* is characterized likewise.

In any case, the present species seems to me to have no near ally in the genus.

ILLUSTRATIONS

TEXT FIGURES

NEW AND RARE PHILIPPINE LEPIDOPTERA

By W. SCHULTZE

Entomologist, Bureau of Science, Manila

TWO PLATES AND ONE TEXT FIGURE

Some species of Lepidoptera known from other localities, which have also been discovered in the Philippines, are recorded in this paper, particularly because of their interesting geographic distribution; also, several new species are described.

PAPILIONIDÆ

Papilio xuthus Linnæus.

Papilio xuthus LINNÆUS, Syst. Nat. (1767) 751; PRYER, Rhop. Nihonica (1886) 3, pl. 1, figs. 2a, 2b; BINGHAM, Fauna Brit. India, Butterfl. 2 (1907) 38.

This species has a very wide range and extends to eastern China, Korea, Japan, Formosa, the Riu Kiu Islands, the Bonin Islands, and Guam. A rather distinct and localized race of this species is found in the higher-mountain regions of northern Luzon, in the Philippines, which to my mind should be designated as *Papilio xuthus* subsp. *benguetana* Joicey and Talbot. These authors described the Philippine form or race of *xuthus* as *Papilio benguetana*,[1] based on a single specimen. Five specimens before me show very little variation; they have characters intermediate between the Japanese summer form, or typical *xuthus* Linnæus, and the spring form, or var. *xuthulus* Bremer. My specimens were collected in May, 1909, in Luzon, Benguet Subprovince, Haight's Place (2,450 meters), by R. C. McGregor.

SATURNIIDÆ

Actias maenas Doubleday.

Actias maenas DOUBLEDAY, Ann. & Mag. Nat. Hist. 19 (1847) 95, pl. 7, fig. 1; HAMPSON, Fauna Brit. India, Moths 1 (1892) 14.

A single female specimen agrees perfectly with the original description, as well as with Doubleday's figure. A single male

[1] Entomologist 56 (1923) 273.

is in a bad state of preservation, the tails from near the base to the beginning of the apical expansion are sprinkled with very dark brown, on upper side and underside. Length of forewing, female, 78 millimeters; length of tail, from upper margin of eyespot on hind wing to apex, 111; length of tail, male, 128 millimeters.

LUZON, Benguet Subprovince, Baguio, 1,450 meters, June 14, 1912 (*Mrs. D. C. Worcester*); May 21, 1921 (*W. D. Smith*).

EUPTEROTIDÆ

Melanothrix nymphaliaria sanchezi subsp. nov. Plate 2, figs. 1 and 2.

Female.—Wings very pale creamy white with brownish black markings as follows: Forewing, basal area from costa to vein 2 with a subtriangular patch and along costa suffused brownish. An outer marginal band, broadest at costa, extending to hind margin; the inner edge of this band undulated and the outer edge interrupted by oblong tooth spots. Hind wing with a marginal band similar to the one on forewing. Underside of both wings identical with upper side. Head, antennæ, and collar brownish black, thorax dorsally white, ventrally suffused brownish, legs brown. Abdomen dorsally, except apical half of last segment, brownish black, but densely scattered with white scales so that the color appears grayish; hind margins of segments with a cilia of white scales forming indistinct narrow white bands. Underside of abdomen and apical half of last segment dorsally yellow ochraceous.

Male.—Wings and body dorsally uniformly dark reddish brown, costa and cilia along outer margin of a darker shade; underside of wings and body paler brown.

Length of forewing, male, 39 millimeters; female, 38 to 41.

LUZON, Benguet Subprovince, Baguio, Mount Mirador, 1,600 meters (*F. Sanchez* and *T. Hubbel*).

The five female specimens before me, all from the above locality, show almost no variation in the markings. Another local form of the above I designate as—

Melanothrix nymphaliaria sanchezi var. baletana var. nov. Plate 2, fig. 3.

Wings snow white, with brownish black markings similar as in subsp. *sanchezi* but occupying a larger area. The basal dark area of forewing extends between veins 2 and 4 to the marginal band, which is much broader than in *sanchezi*. In the hind wing the marginal band is also much broader. A further

peculiarity is that the outer margin of the forewing is more rounded than in subsp. *sanchezi* and the typical form of *nymphaliaria* Walker. The abdomen is dorsally more blackish in this variation than in subsp. *sanchezi*.

Length of forewing, female, 38 millimeters.

LUZON, Nueva Vizcaya Province, near Balete Pass, about 1,000 meters altitude (*Schultze*).

It appears that both subsp. *sanchezi* and var. *baletana* represent intermediate forms leading to *M. nymphaliaria philippina* Rothschild,[2] the latter of which Semper [3] designated in the text as *M. pulchricolor* Felder, from Polillo, but in the explanation of his Plate 2, fig. 2, it is called *M. nymphaliaria* Walker, var. The Mindanao specimens of Semper's *M. pulchricolor* Felder were described by Rothschild [4] as *M. semperi;* the brief description mentions that the abdomen is yellow with black transverse bands. Still another Philippine species of this genus is *M. alternans* Pagenstecher from Palawan.

BOMBYCIDÆ

Gunda javanica palawana subsp. nov.

Female.—Very similar in general coloration to typical *G. javanica* Moore,[5] but differing as follows: Apex of forewing less pointed, more obtusely rounded than in the above. Costa near apex with an elongate brownish patch, the dark brown patch at apex and outer margin more prominent. Underside of forewing, outer marginal area dark brown, two distinct dark brown postmedial bands, basal area light grayish brown. Underside of hind wing with a blackish discocellular spot, a prominent dark brown medial band, and a narrower postmedial band, both of which extend from costal to inner margin. Length of forewing, female, 32 millimeters.

PALAWAN, Ulugan Bay, on ship's search light (*Schultze*).

Gunda sikkima Moore.

Gunda sikkima MOORE, Proc. Zool. Soc. London (1879) 406, pl. 33, fig. 3.

According to Hampson this species is identical with his *G. variegata* [6] and *G. thwaitesii* Moore. A male specimen of this

[2] Novit. Zool. 24 (1917) 464.
[3] Die Schmetterl. d. Philip. Inseln 2 (1896–1902) 387.
[4] Novit. Zool. 24 (1917) 465.
[5] Proc. Zool. Soc. London (1872) 576, pl. 33, fig. 6; Hampson, Fauna Brit. India, Moths 1 (1892) 36, fig. 20.
[6] Ill. Het. Brit. Mus. 9 (1893) 55, pl. 160, fig. 7.

species agrees very well with the indicated figure of *variegata*, except that the thorax and the abdomen are lighter in general color in the Philippine specimen.

Length of forewing, male, 18 millimeters.

MINDANAO, Agusan, Butuan, October, 1910 (*Schultze*).

SYNTOMIDÆ

Euchromia tawiensis sp. nov.

Wings in color and pattern similar to *E. elegantissima* Wallengrén, but the spots on the hind wing relatively larger than in the species mentioned. First abdominal segment above creamy white, second and third black with traces of light bluish scales and a white spot at sides. Fourth and fifth segments crimson, other segments black.

Length of forewing, male, 18 to 23 millimeters; female, 21.5.

BUNGAU, in the Tawitawi group, Sulu Province (*A. Duyag*).

My collector obtained three specimens of this interesting species, which is related to *E. polymena* Linnæus and *E. elegantissima* Wallengrén but is at once distinguished from the latter and other related species by the fourth and fifth abdominal segments only being crimson. *Euchromia elegantissima* ranges from Luzon to Mindanao but seems to be replaced in the Sulu group by *E. tawiensis,* and in Palawan, Dumaran (Bureau of Science collection, accession No. 17965, August 27, 1913, *Schultze*), Cuyo (accession No. 10857, April 10, 1909, *Schultze*), and Busuanga (accession No. 13989, September 17, 1910, *Schultze*) by *E. horsfieldi* Moore. The last-mentioned species demonstrates in a marked degree the ancient connection of the Palawan–Busuanga faunistic elements with Borneo, the northern limit of which seems to be Busuanga Island.

ZYGAENIDÆ

CHALCOSIINÆ

Ancistroceron luzonensis sp. nov. Plate 1, fig. 7.

Forewing iridescent dark violet blue, basally with some radiating ochraceous streaks. Hind wing bluish black, basally below the cell with an oblong hyaline area, the space between the latter and the inner margin also ochraceous. Head and thorax ochraceous, abdomen dorsally bluish black, first to fourth segments ventrally silvery whitish, laterally with a marginal band of the same color, the other segments with an indistinct marginal band ventrally.

Length of forewing, male, 15 millimeters.

LUZON, Benguet Subprovince, Baguio (*Schultze*), April, 1925.

The insects of this species feed on *Medinilla* sp., which is abundant around Baguio.

Cyclosia sordidus subsp. bungauensis subsp. nov. Plate 1, fig. 3.

Cyclosia sordidus WALKER, Journ. Linn. Soc. 6 (1862) 98.

Forewing greenish black with a postmedial pale creamish white oblique band consisting of elongate spots. Hind wing pale creamy white with an irregular blackish band at outer margin. Underside of fore and hind wings similar to upper side but with an additional series of small whitish submarginal spots. Antennæ, head, thorax, and abdomen greenish black, the latter ventrally white-banded.

Length of forewing, female, 27 millimeters.

BUNGAU, Tawitawi group (*A. Duyag*).

Milleria adalifoides sp. nov. Plate 1, fig. 4.

Wings creamy white. Forewing with all the veins brownly marked. Hind wing with some ill-defined and suffused brownish submarginal spots. Underside with the veins less strongly brownish streaked, both wings with an ill-defined submarginal brownish band consisting of oblong more or less confluent spots. Hind wing with the costal margin brownish and the inner marginal area below the cell up to the submarginal band yellow. Antennæ brownish, thorax and abdomen grayish white.

Length of forewing, female, 24.5 millimeters.

DUMARAN, near Palawan (*Schultze*), Bureau of Science collection (accession No. 17967).

This species is a true *Milleria*, and is slightly related to *M. adalefa* Doubleday.[7]

COSSIDÆ

Xyleutes plesseni sp. nov. Plate 1, fig. 5.

Wings pale flesh colored but the greater part of the area, particularly of the forewing, suffused with pale grayish marmorated blotches. Forewing with the pale flesh ground color forming an elongate patch on the costa at apex and an irregular area along the hind margin. Hind wing with the marginal areas

[7] Ann. & Mag. Nat. Hist. 19 (1847) 76; Seitz, Gross-Schmetterl. d. Erde 10 (1907) 36, pl. 7, fig. a3.

flesh colored, also thorax and abdomen dorsally. Other parts of the body and legs grayish.

Length of forewing, male, 30 millimeters.

LUZON, Manila, at light, February, 1911 (*G. v. Plessen*), Bureau of Science accession No. 14276.

I name this species in honor of its collector, Baron Gustav von Plessen ✠, who donated it to the Bureau of Science collection.

DREPANULIDÆ

Genus SILVASPICA novum

Palpi very long, first and second joints thickly scaled, second joint longest, slightly longer than third, the latter very slender. Proboscis present. Antennæ of male with the branches long in basal half, extremely short in apical half. Mid and hind tibiæ with one pair of spurs. Forewing with vein 4 from lower angle of cell, 6 from upper angle, veins 7 and 8 from end of areole. Hind wing with the margin very slightly produced at vein 4; veins 6 and 7 forked a short distance beyond the cell. Frenulum present.

Type species, *S. baletensis* sp. nov., from Luzon.

Silvaspica baletensis sp. nov. Plate 1, fig. 1; text fig. 1.

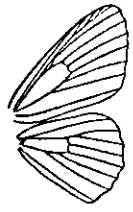


FIG. 1. *Silvaspica baletensis* g. et sp. nov., wing venation.

Wings light yellow. Forewing with a dark grayish blue marginal band along costa and outer margin, broadest at apex. Hind wing with a similar band along outer margin. Antenna and vertex of head also grayish blue, front of head, palpi, thorax, abdomen, and legs pale yellow. Fore legs with the femora and tibiæ streaked with grayish blue.

Length of forewing, males, 18.5 to 20 millimeters.

LUZON, Nueva Vizcaya Province, near Balete Pass (*Schultze*): Isabela Province, San Antonio (*C. S. Banks*).

This new genus seems to be allied, according to the wing venation, to the genus *Spica*[8] Swinhoe. The species is remarkable on account of its striking geometrid aspect. It was found flying in large numbers during the whole day along the jungle trail near Balete Pass, in the first half of April.

[8] Proc. Zool. Soc. London (1889) 424; Hampson, Fauna Brit. India, Moths 1 (1892) 342.

ARCTIIDÆ

LITHOSIINÆ

Chionaema benguetana sp. nov. Plate 1, fig. 2.

Forewing bright brick red, basally at upper half a large white patch, from which a narrow oblique white band extends to hind margin. A black line along the outer margin of the white patch and band. In the cell an elongate white patch within which a black round spot is located. A postmedial narrow wavy white band, the inner margin of which is set off by a black line. Hind wing uniformly pale flesh colored. Front of head, collar, and thorax above white, tegulæ, palpi, and legs pale crimson reddish, abdomen pale reddish.

Length of forewing, female, 25 millimeters.

LUZON, Benguet Subprovince, mountains near Irisan, March, 1925 (*Schultze*).

GEOMETRIDÆ

Tigridoptera benguetana sp. nov. Plate 1, fig. 8.

Wings pale slate gray with elongate ochraceous streaks and small black spots. Forewing with an ochraceous streak extending from the discocellular toward the outer margin; basal area also ochraceous and continued as an elongate streak between veins 1a and 1b. Hind wing with two streaks of the same color, one reaching from the base through and beyond the cell, the other between veins 1a and 1b to the postmedial region. Forewing with five subbasal black spots, four above the ochraceous streak and one below, a small black discocellular spot and six or seven spots forming an oblique medial row. Hind wing with a black discocellular spot, also with an oblique medial row and faint traces of a secondary subparallel row of spots. Underside of wings pale slate gray with a rather large discocellular black spot. Head, collar, thorax, first abdominal segment, and legs gray, collar with two black spots, tegulæ streaked with ochraceous and one black spot, thorax with two spots. Second to last abdominal segments pale yellow ochraceous.

Length of forewing, female, 29 millimeters.

LUZON, Benguet Subprovince, Baguio (*F. Sanchez*).

The above species seems to be related to *T. subradiata* Warren [9] but differs from the latter and other [10] related species in

[9] Novit. Zool. 6 (1899) 48.

[10] Semper, Schmetterl. d. Philippinen 2 (1896-1902) 617.

that the underside of the hind wing has no black submarginal fascia.

HYPONOMEUTIDÆ

Ethmia palawana sp. nov. Plate 1, fig. 6.

Forewing creamy white with numerous small black spots as follows: Four spots near base, four others form an irregular oblique antemedial row, in the middle along the subcosta an elongate black streak, and below this a medial and a postmedial black spot. Subapically along costa three small spots and below these a series of five spots. Outer margin with a row of seven small squarish spots. Hind wing pale grayish brown, inner marginal area, in male, with long hair and creamy white cilia. Head, palpi, thorax, and legs also creamy white with black spots. Abdomen ochraceous.

Length of forewing, male, 18.5 millimeters.

PALAWAN, Iwahig (*C. M. Weber*).

This species is related to *E. lineatonotella* Moore [11] from Darjeeling, India, but differs in having only one black line on the forewing and, besides other differences, the color of the hind wing is lighter than in the latter species.

[11] Proc. Zool. Soc. London (1867) 669, pl. 33, fig. 18.

ILLUSTRATIONS

[Original drawings by W. Schultze.]

PLATE 1

FIG. 1. *Silvaspica baletensis* g. et sp. nov.
2. *Chionaema benguetana* sp. nov.
3. *Cyclosia sordidus bungauensis* subsp. nov.
4. *Milleria adalifoides* sp. nov.
5. *Xyleutes plesseni* sp. nov.
6. *Ethmia palawana* sp. nov.
7. *Ancistroceron luzonensis* sp. nov.
8. *Tigridoptera benguetana* sp. nov.

PLATE 2

FIG. 1. *Melanothrix nymphaliaria sanchezi* subsp. nov., male.
2. *Melanothrix nymphaliaria sanchezi* subsp. nov., female.
3. *Melanothrix nymphaliaria sanchezi* var. *baletana* var. nov., female.

TEXT FIGURE

FIG. 1. *Silvaspica baletensis* g. et sp. nov., wing venation.

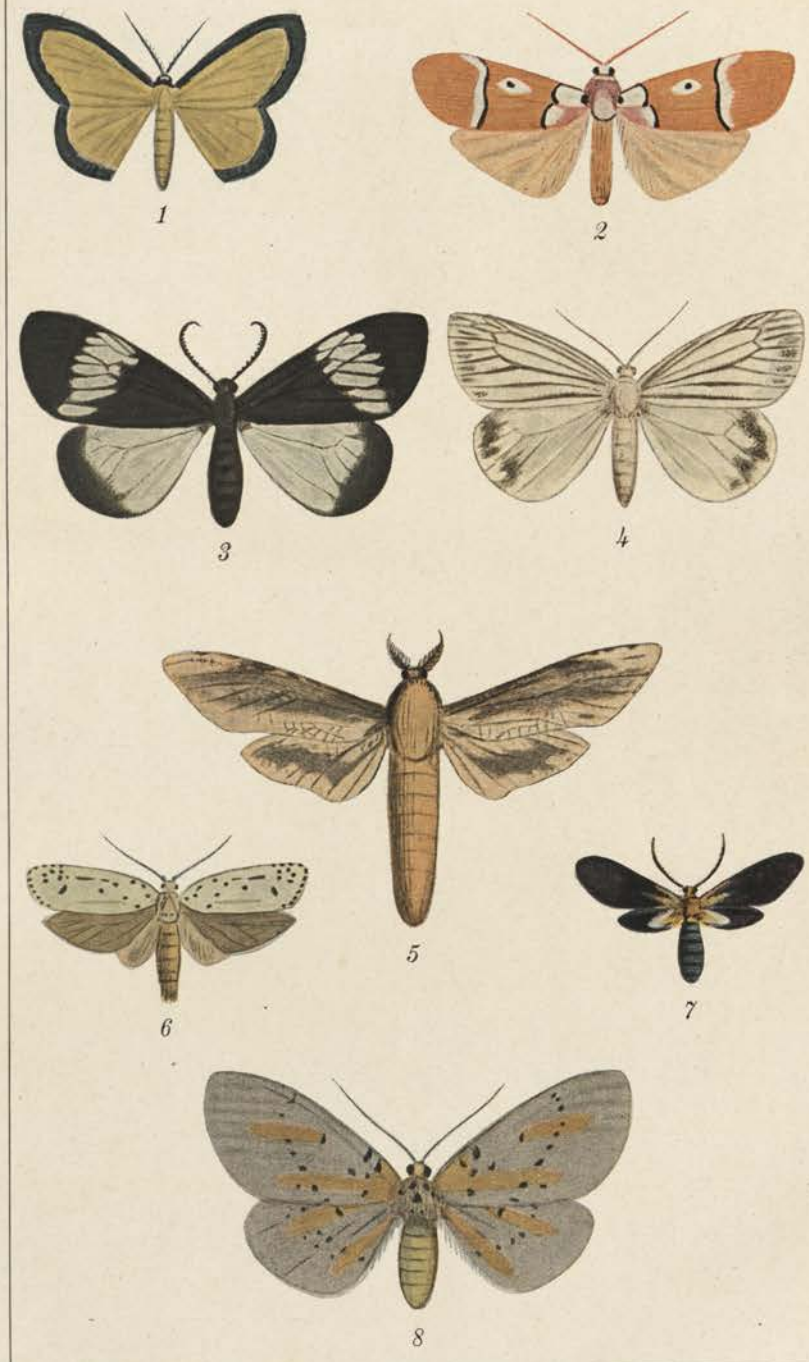


PLATE 1.

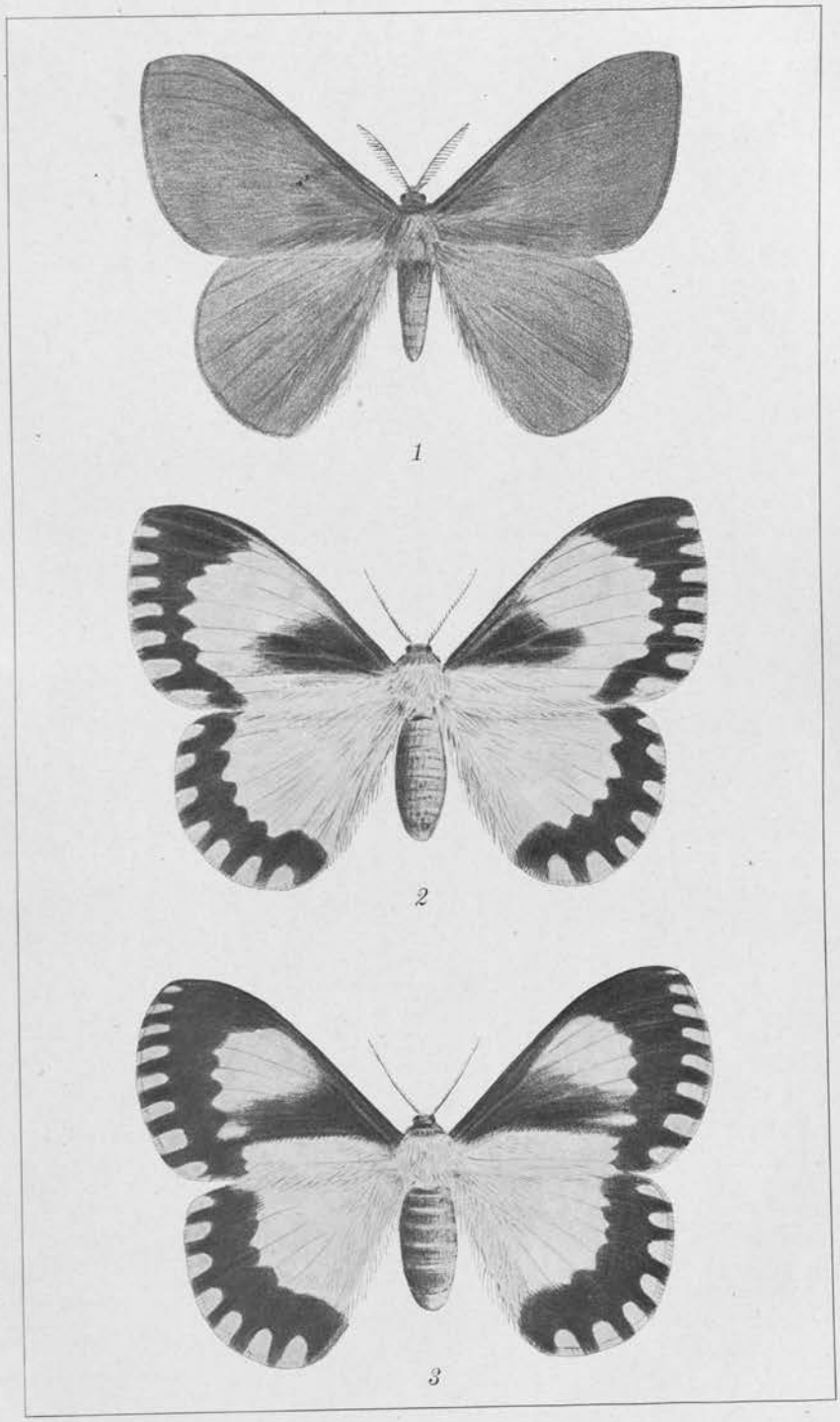


PLATE 2.

NEUE HOPLIONOTA-ARTEN (COLEOPTERA, CHRYSOMELIDÆ, CASSIDINÆ) AUS DEN PHILIPPINEN, II

Von FRANZ SPAETH

Vienna, Austria

Unter den Cassidinen welche mir Herr Charles F. Baker zur Bestimmung übersandte, befanden sich einige neue *Hoplionota*-Arten. Die Anzahl der von den Philippinen beschriebenen endemischen Arten dieser Gattung ist 24, von welchen 18 durch die Sammeltätigkeit des Herrn Baker gefunden wurden. Ohne zweifel stellt diese Anzahl nur ein kleiner Teil der philippinischen *Hoplionota* dar, und dürfen wir hoffen dass noch mehrere Arten dieser interessanten Gattung gefunden werden.

Hoplionota butuana sp. nov.

Subquadrata, modice convexa, haud nitida, dilute brunnea subtus flavotestacea; crista frontalis oculos sat superans, apice dilatato rotundata et emarginata; prothorax brevis, basi subtruncata, angulis rectangulis, lateribus antice rotundatis; elytra disco striato-punctato, costa dorsali et humerali, illa tuberculo basali mediocri, postbasali parvo, principali sat alto, valde acuto, apicali parvo; carina pontali et suturali, hac abbreviata, apicali, furca interna abbreviata; protectum deplanatum, obsolete punctatum. 5.5 × 5 mm.

MINDANAO, Butuan (*Baker*).

Annähernd rechteckig, um die Hälfte länger als breit, mit der grössten Breite hinter den Schultern noch vor der Mitte der Flügeldecken; von hier nach rückwärts stärker, fast geradlinig, nach vorne kaum verengt; wenig gewölbt, mässig glänzend, braun, die Scheibe des Halsschildes und ihre Umgebung, das Schildchen und der Innenteil des Seitendaches hinter der Basis heller, bräunlichgelb, zum Teil durchscheinend; auch einzelne Teile der Kiele, insbesonders vorne der Dorsalkiel, sind heller als ihre Umgebung; unten bräunlichgelb, nur die Epipleuren hellbraun.

Die Kopfplatte überragt die Augen fast um deren Durchmesser, ist vorne verbreitert, gerundet, die Mitte des Vorderrandes schmal und kurz ausgerandet. Die Fühler reichen nicht bis

zu den Halsschildecken,[1] ihr drittes Glied ist sehr klein, kaum halb so lang als das vierte, das vierte bis siebente sind lang, das achte bis zehnte verdickt, kaum länger als breit. Halsschild wie bei *taeniata* gebildet, dreimal so breit als lang, die Basis aussen nur wenig vorgezogen, die Ecken rechtwinklig, die Seiten vor ihnen zuerst noch parallel, dann in starkem Bogen zum Kopfausschnitt gerundet, die Scheibe glatt, mit sehr schwachem vorderen und viel tieferem und kräftiger punktiertem Basalquereindruck, die Seitenflügel mit zerstreuten Grubenpunkten. Flügeldecken kaum merklich breiter als die Basis des Halsschildes, ihre Basis mit ziemlich feinen Punktstreifen und gut ausgebildeten Rippen und Höckern. Der Dorsalkiel ist zwischen dem Basal- und dem Postbasalhöcker kurz unterbrochen; der erstere Höcker ist lang gestreckt, ziemlich hoch, der letztere kleiner; der Haupthöcker liegt etwas weiter aussen, daher die Dorsalrippe hier sich von der Naht entfernt, ist höher als breit, dreimal so hoch als der Basalhöcker, sehr scharf und spitz, vierkielig; der Apikalhöcker ist um die Hälfte niedriger als der Haupthöcker; der Humeralkiel biegt sich an der Basis nach aussen, so dass er ausserhalb der Schulterbeule beginnt, und läuft dann niedrig bis zur Pontalleiste; diese ist aussen schwach, steigt innen auf den Haupthöcker, auf dem sich Längs- und Querkiel in demselben Schnittpunkte treffen, und setzt sich steil abfallend als Suturalleiste bis zum ersten Punktstreif fort; der Apikalkiel ist vollständig, seine drei Anhänge sind kurz, die furca interna erlischt weit von der Pontalleiste entfernt. Das Seitendach hat die gewöhnlichen Grubenpunkte, die aber überall, besonders innen nächst der Seitendachbrücke, sehr seicht und zum Teil erloschen sind.

Hoplionota butuana steht am nächsten der *taeniata* Fabricius, die mir bisher nur von Luzon und Sibuyan, sonach von mehr nördlich gelegenen Inseln der Philippinen vorliegt; sie unterscheidet sich von ihr durch die braune Oberseite ohne rötliche Beimischung, ferner durch kräftiger ausgebildete Höcker, insbesonders den sehr hohen und spitzigen Haupthöcker, bei *taeniata* ist der Haupthöcker niedrig, viel breiter als hoch; ferner ist bei *butuana* der ganze äussere Rand des Seitendaches gleichmässig dunkel, während man bei *taeniata* stets in der Mitte und hinten neben der Spitze helle bis an den Rand reichende Stellen sehen kann und das Seitendach sonach eigentlich je zwei dunkle Randäste hat.

[1] Die Fühler des Weibchens sind bei den meisten *Hoplionota*-Arten, besonders bei *taeniata*, wesentlich kürzer als beim Männchen.

Hoplionota demutata sp. nov.

Ebenfalls der *H. taeniata* äusserst nahe verwandt, vielleicht sogar nur eine Rasse derselben. Grösser und breiter, nach hinten stärker verengt, oben hell ziegelrot, das Seitendach innen vor der Brücke und an der Spitze heller, in gelb verbleichend. Die Anlage der Rippen und Höcker ist die gleiche, aber die Höcker der Dorsalreihe sind durchwegs höher, der Haupthöcker so hoch als breit, viel höher über die Dorsalrippe hinausragend; die furca interna reicht weiter gegen den Haupthöcker; letzterer ist gegenüber *butuana* viel stumpfer und niedriger; auch ist der Umriss bei dieser viel schmäler. Grösse, 6 × 5 Millimeter.

NEGROS, Cuernos Mountains (*Baker 21500*).

Hoplionota sibuyana sp. nov.

Rotundato-ovata, parum convexa, subnitida, supra sanguinea, subtus testaceorufa epipleuris laete sanguineis; crista frontalis oculos sat superans, antice dilatata, apice rotundato medioque inciso; prothorax brevis, basi extus parum producta, angulis posticis rectangulis, lateribus oblique rotundatis, disco transversim biimpresso ibique punctato, lateribus profundius minus crebre punctatis; elytra punctato-striata, carinis nec tuberculis, illis non interruptis; protectum latum, deplanatum, extus sat crebre punctatum, intus antice sublaeve. 6.2 × 5.2 mm.

SIBUYAN (*Baker*).

Eiförmig-gerundet mit der grössten Breite vor der Mitte der Flügeldecken, von hier zu den Schulterecken wenig, zur Spitze stärker verengt, breiter und gerundeter als alle bisher von den Philippinen bekannten Arten, sehr wenig gewölbt. Die Oberseite lebhaft blutrot, einfarbig, nur die Scheibe des Halsschildes und die weniger dicht punktierte Schwiele auf dem Seitendache innen vor der Seitendachbrücke etwas heller mit gelblichem Stich; die Unterseite rötlich gelb, die Epipleuren hell blutrot, in gelb verbleichend.

Die Kopfplatte überragt die Augen etwa um die Hälfte ihrer Länge, ist vor denselben erweitert, dann im Bogen zugespitzt, mit kurzem Mitteleinschnitt; der Kopf ist zwischen den Augen schmal, schmäler als bei *modesta* Wagener, schwach ausgerandet. Die Fühler erreichen bei weitem nicht die Halsschildecken und haben vier mässig verdickte, eine kurze Keule bildende Endglieder, die wesentlich dicker als lang sind; das siebente Glied ist nur wenig nach dem Ende zu verdickt, gut um die Hälfte länger als das achte; das dritte Glied ist nur so lang als das

zweite, das vierte, fünfte und sechste sind nur wenig länger, kürzer als das siebente. Im Verhältnis zu *modesta* sind die Fühler viel kürzer, besonders die Keule ist kürzer und daher anscheinend dicker, das vierte bis siebente Glied sind ebenfalls weniger gestreckt.

Halsschild kurz, dreimal so lang als breit; seine Basis von den Basalzähnen an schwach vorgezogen, die Hinterecken sind rechtwinklig, die Seiten gleich vom Beginn an in sehr schräg verlaufendem Bogen verengt; der Kopfausschnitt ist sehr kurz, mit sehr schrägen Seiten, kürzer und mehr trichterförmig als bei *modesta;* die Scheibe ist bis auf die gewöhnlichen zwei punktierten Quereindrücke glatt; die Seitenflügel haben die gewöhnliche grobe, nicht sehr tiefe Punktierung.

Flügeldecken an der Basis kaum breiter als der Halsschild, mit rechtwinkligen, wenig abgestumpften Schulterecken; die Scheibe mit groben, nur stellenweise regelmässigen Punktstreifen. Die Dorsalrippe ist nur zwischen Basal- und Postbasalhöckerstelle unterbrochen, sonst vollständig; vor dem Haupthöcker ist sie etwas nach aussen gebogen; der Humeralkiel ist im Basalteil erloschen, dann aber bis zur Pontalleiste fast ebenso hoch wie der Dorsal; die Pontalleiste ist ebenso hoch, kräftig, und setzt sich als Suturalleiste schräg nach vorne gerichtet, bis an die Naht fort, mit deren Kante sie sich verbindet; die Apikalleiste beginnt innen vom Dorsal, ohne die Nahtkante zu erreichen; die costa ultima [2] und terminalis, sowie die furca externa und interna sind vollständig ausgebildet; letztere erreicht die Pontalleiste nur wenig weiter innen als der Humeralkiel; Höcker fehlen; die Schnittpunkte des Haupt-, des Apikal- und des Marginalhöckers sind kaum höher als die Rippen. Das Seitendach hat die gewöhnlichen, groben Punkte, welche nur innen vor der Seitendachbrücke eine glatte Beule freilassen; die Aussenrandung ist undeutlich.

Hoplionota impicta sp. nov.

Subquadrata, parum convexa, minus nitida, laete ferruginea, subtus dilutior; crista frontalis oculos sat superans, antice dilatata, apice rotundato medioque inciso; prothorax brevis, basi extus parum producta, angulis posticis subrectis, lateribus oblique rotundatis, disco transversim biimpresso et punctato, lateribus profundius minus crebre punctatis, elytra punctato-

[2] Ueber diese Bezeichnungen siehe Spaeth, Verh. Zool. bot. Ges. (1913) 383.

striata, carinis modicis hic illic subeffusis, nec tuberculis; protectum latum, subdeplanatum, minus profunde punctatum. 6 × 5 mm.

MINDANAO, Surigao (*Baker 17035*).

Rechteckig, nahezu quadratisch, wenig gewölbt und kaum glänzend, rostrot mit gelblichem Stiche, unterseits etwas heller rotgelb. Die grösste Breite liegt in der Mitte der Flügeldecken, von hier nach hinten sehr schwach verengt, hinten breit abgestutzt-verrundet.

Die Kopfplatte überragt die Augen fast um deren ganze Länge, ist längsgerinnt, zwischen den Augen schwach verengt, dann bis zur Mitte der Augen erweitert, an der Spitze verrundet und kurz eingeschnitten. Fühler wie bei *sibuyana*, doch ist das dritte Glied kürzer als das zweite.

Halsschild wie bei *sibuyana*, aber mit etwas spitzer gewinkelten Ecken; auch gleichartig punktiert. Flügeldecken an der Basis von der Breite des Halsschildes, mit rechtwinkligen, kaum abgestumpften Schulterecken, groben, meist regelmässigen Punktstreifen und sehr niedrigen Rippen, ohne Höcker; die Dorsalrippe ist nur nach dem Basalhöcker unterbrochen, sonst vollständig und fast gerade; die Humeralrippe ist an der Basis fast erloschen, dann sehr schwach entwickelt und trifft die Pontalleiste weit aussen; letztere ist niedrig, aber von der Seitendachbrücke bis zur Naht gut erkennbar, als Suturalleiste verläuft sie quer, nicht nach vorne gerichtet. Die Apikalleiste ist rudimentär, beginnt erst aussen von der Dorsalrippe, ohne diese zu berühren; ihre äusseren Fortsätze sind zwar durchwegs vorhanden, aber abgekürzt; die Schnittpunkte sind kaum höher als die Rippen. Das Seitendach ist flach ausgebreitet, grob punktiert, ohne glatte Stellen, breit, mit ziemlich deutlicher Aussenrandung.

Hoplionota impicta steht am nächsten der *sibuyana* und unterscheidet sich von ihr durch die rostrote, mehr gelbliche Färbung, kürzeren, breiteren, nach hinten weniger verengten Umriss, weiter hinten liegende grösste Breite, niedrigere Kiele und Leisten; bei den letzteren bestehen ferner folgende Verschiedenheiten: Der Dorsalkiel ist in der Mitte nicht nach aussen gebogen und wird von der Apikalleiste nicht geschnitten; die Suturalleiste ist nicht nach vorne gebogen und verbindet sich nicht mit der Nahtkante; die furca interna erreicht nicht die Pontalleiste, der Humeralkiel ist an der Basis erloschen, dann gerade.

Hoplionota formosa sp. nov.

Subquadrata, parum convexa, nitida, testaceoflava, elytra utrinque maculis tribus piceis, prima pone callum humeralem, altera circum gibbum principalem, tertia subeffusa in protecto interiore mox pone pontem; crista frontalis magna, oculos valde superans, subacuminata, apice profunde incisa; prothorax disco transversim biimpresso et punctato, ceterum laevi, lateribus profunde punctatis; elytra profunde punctato-striata, gibbo principali ceteris parum altiore, costa humerali et furca interna effusis, costa suturali obliqua, sat alta; protectum latum deplanatum, profunde punctatum. 6.5 × 5.5 mm.

MINDANAO, Surigao (*Baker 17036*).

Eiförmig, rechteckig, um die Hälfte länger als breit, wenig gewölbt, glänzend, bräunlichgelb, auf den Flügeldecken je drei pechschwarze Makeln, die erste zwischen Schulterbeule und Seitendach, die zweite umgibt den Haupthöcker, die dritte ist weniger kräftig und steht hinter der Seitendachbrücke, zum Teil auf dem Seitendach; auch hinter der Apikalleiste ist die Scheibe etwas dunkler, leicht gebräunt, ohne bestimmte Fleckenbildung. Die Fühler überragen die Halsschildecken, das vierte bis siebente Glied sind gestreckt, das achte bis zehnte kurz, kaum länger als dick, die Kopfplatte überragt die Augen um mehr als die Hälfte von deren Länge, ist zwischen ihnen verengt, dann erweitert und zugespitzt zusammenlaufend mit tiefen Schlitz. Halsschild dreimal so breit als lang, wie in den verwandten Arten gebildet und punktiert, mit bis auf die zwei punktierten Quereindrücke glatter, glänzender Scheibe und grob und mässig dicht punktierten Seitenteilen; die Hinterecken sind rechtwinklig, die Seiten vor ihnen erst gerade, dann stark gerundet. Flügeldecken kaum breiter als der Halsschild, an den Seiten nur sehr schwach erweitert, hinten breit verrundet; die Scheibe mit groben Punktstreifen; die Dorsalrippe mit Ausnahme der Unterbrechung zwischen Basal- und Postbasalhöcker vollständig und hoch, am Haupthöcker nach aussen, am Apikalhöcker nach innen gerichtet, ersterer daher weiter von der Naht entfernt; der Basalhöcker lang und ziemlich hoch, der Postbasal unbedeutend, der Haupthöcker und Apikal kaum höher als der Basal; der Humeralkiel ist fast erloschen; die Pontalleiste geht nur vom Haupthöcker bis zum sechsten Punktstreif; die Suturalleiste ist hoch, sehr stark nach vorne zur Naht gerichtet, mit der Nahtkante verbunden; die Apikalleiste ist ziemlich kräftig aber kurz, von ihren Anhängen nur die costa ultima vorhanden, die furca in-

terna und externa fehlen dagegen. Seitendach breiter als eine halbe Flügeldecke, flach ausgebreitet, mit groben, nächst der Seitendachbrücke spärlicheren Punkten.

Hoplionota formosa hat fast die gleiche Zeichnung wie *H. sexnotata* Weise von Luzon, sie ist aber oben mehr braungelb, weniger rötlich; der Umriss ist breiter; ganz verschieden ist die Skulptur der Flügeldecken, da bei *sexnotata* die Suturalleiste gekürzt ist und die Apikalleiste fehlt; auch sind bei ihr die Höcker noch niedriger. Von *H. modesta* Wagener aus Luzon ist *formosa* durch gesättigtere Färbung, andere Zeichnung, längere, verhältnissmässig schmälere Gestalt, viel niedrigeren Haupt- und Apikalhöcker, dichtere Punktierung der Flügeldecken verschieden. Am nächsten steht *formosa* der *H. undulata* Wagener von Mindanao, deren Typus ich besitze. Diese ist mehr gesättigt gefärbt und anders gezeichnet, auf den Flügeldecken wesentlich gröber punktiert, der Haupthöcker ist höher, die Suturalleiste erreicht nicht die Nahtkante, die Apikalleiste setzt sich auch innen über den Dorsalkiel fort, ihre Anhänge sind durchwegs ausgebildet, das Seitendach ist schmäler, ebenso der ganze Umriss; der Halsschild ist etwas länger, seine Scheibe, besonders im vorderen Eindruck, kräftiger punktiert.

Hoplionota negrosia sp. nov.

Subquadrata, parum convexa, subopaca, supra laete ferruginea, subtus parum dilutior testaceo-flava, elytra utrinque maculis duabus nigris, prima in costa pontali, altera in costa apicali; crista frontalis oculos sat superans, apice dilatata et rotundata incisione parva; prothorax disco transversim biimpresso et punctato, ceterum laevi, lateribus punctis magnis, haud profundis, sat sparsis; elytra profunde punctato-striata, bicarinata nec tuberculata, furca interna extus cum pontali conjuncta; protectum latum, deplanatum, obsolete punctatum. 7 × 6 mm.

NEGROS, Cuernos Mountains (*Baker*).

Rechteckig, kaum um die Hälfte länger als breit, bald nach den Schultern am breitesten, nach vorne und hinten nur wenig verengt, hinten breit gerundet, kaum glänzend, unten rötlich gelb, die Oberseite hell rostrot mit gelblicher Beimischung, innen auf dem Seitendache vor der Pontalbrücke und auf dem Vordache wenig heller durchscheinend, mit zwei schwarzen Flecken auf jeder Flügeldecke; der erste liegt auf der Pontalleiste und ihrer Umgebung, ist quer und reicht vom Schnittpunkt mit dem Humeralkiel bis zu jenem mit dem Dorsalkiel, also dem Haupt-

höcker; der zweite liegt über der Apikalleiste, ebenfalls quer und mit derselben Ausdehnung; in beiden Fällen sind auch die Fortsätze der Querleisten gegen die Naht anfangs schwarz.

Die Kopfplatte ist ähnlich wie bei den vorherigen Arten, kürzer vor die Augen vorgezogen, vorne breit gerundet, mit sehr kleinem, kurzen Einschnitt. Die Fühler reichen nicht bis zu den Halsschildecken, ihr drittes Glied ist wenig kürzer als das zweite, die äusseren Glieder sind fast um die Hälfte breiter als lang. Halsschild kurz, dreimal so breit als lang, mit aussen kaum vorgezogener Basis, rechtwinkligen Ecken und anfangs geraden, dann stark gebogenen Seiten; die wenig glänzende Scheibe hat die gewöhnlichen zwei punktierten Quereindrücke, die Seitenteile haben sehr verloschene, grobe Punkte, die ziemlich spärlich stehen. Die Flügeldecken sind so breit als der Halsschild, mit groben Punktstreifen auf der Scheibe; der Dorsalkiel ist nicht unterbrochen und reicht fast bis sur Spitze; er ist am Haupthöcker kaum nach aussen gebogen; die Höcker auf ihm sind niedrig, kaum als solche erkennbar. Eine bemerkenswertere Bildung zeigt der etwas niedrigere Humeralkiel; er beginnt schon an der Basis auf dem sechsten Zwischenraum, geht dann parallel mit dem Dorsalkiel bis zur Pontalleiste und setzt sich auch nach dieser als furca interna auf demselben Zwischenraum bis zur Apikalleiste fort während sonst diese furca entweder zum Haupthöcker wendet oder erlischt; die anderen drei Nebenleisten der Apikalleiste sind abgekürzt. Die Pontalleiste ist aussen erloschen und setzt sich als Suturalleiste schräg nach vorne zur Naht fort, ohne letztere zu erreichen; die gleiche Bildung zeigt die Apikalleiste. Das Seitendach ist breit, ausgebreitet, mit groben, aber sehr seichten und stellenweise verloschenen Grubenpunkten und einer glatteren, helleren Stelle innen vor der Seitendachbrücke.

In Grösse, Färbung, und Zeichnung erinnert *H. negrosia* an *sexnotata* Weise; sie unterscheidet sich jedoch von dieser, sowie von allen anderen Arten der Philippinen, durch den Verlauf der furca interna.

Hoplionota delicatula sp. nov.

Breviter ovalis, modice convexa, nitida, flavotestacea, elytra maculis utrinque duabus nigris, prima ad callum humeralem, altera in costa pontali; crista frontalis oculos valde superans; antennae sat breves, articulis 4 ultimis clavam formantibus; prothorax brevis, longitudine triplo latior, angulis posticis rectangulis, lateribus valde rotundatis, disco transversim biimpresso,

lateribus profunde sat crebre punctatis; elytra prothorace parum latiora, mox pone humeros latissima, tum lateribus parum obliquatis, disco sat fortiter punctato-striato, costis duabus longitudinalibus, humerali fere obsoleta, costa pontali parum altiore, apicali parva, furcis abbreviatis; protectum deplanatum, profunde, sat crebre punctatum. 5.5 × 5 mm.

MINDANAO, Butuan (*Baker 18857*).

Diese und die folgenden zwei Arten gehören in eine Gruppe sehr ähnlicher Formen, von denen bereits früher *H. sexsignata* von Weise [3] beschrieben wurde und die bisher nur von Mindanao, und zuweilen ausschliesslich aus den Ausbeuten von Ch. F. Baker bekannt wurden.

Hoplionata delicatula hat einen breit-ovalen, schwach trapezförmigen Umriss; die grösste Breite liegt knapp hinter den Schultern; von hier verengt sie sich nach rückwärts mehr und geradlinig, nach vorne schneller, aber nur kurz. Nur unbedeutend länger als breit, mässig gewölbt, ziemlich glänzend, hell bräunlichgelb, auf jeder Flügeldecke mit zwei schwarzen Makeln; die erste kleinere an der Basis des Humeralkiels, innen von der Schulterbeule; die zweite umgibt die Pontalleiste von ihrem Schnittpunkt mit dem Humeralkiel bis über den Haupthöcker.

Die Kopfplatte überragt die Augen um ihren Durchmesser, ist vorne zuerst erweitert, dann breit abgerundet, mit schmalem Einschnitt. Die Fühler sind kurz, reichen nicht bis zu den Halsschildecken und haben vier verdickte Endglieder, die merklich breiter als lang sind; das dritte Glied ist kürzer als das zweite, das vierte kaum länger. Halsschild kurz, dreimal so breit als lang, mit aussen kaum vorgezogener Basis, rechtwinkligen Ecken, dann zuerst geraden, sodann stark gebogenen Seiten; der vordere Quereindruck der Scheibe ist schwach, kaum punktiert; die Seitenflügel tragen grobe, ziemlich dicht stehende Punkte. Die Basis der Flügeldecken ist kaum breiter als der Halsschild; die Punktstreifen der Scheibe sind grob, wenig regelmässig. Die Dorsalrippe ist zwar niedrig, aber gut erkennbar; hinter dem Basalhöcker unterbrochen, nach dem Postbasal kaum eingesenkt, vor dem Haupthöcker stark nach aussen gebogen; hinter diesem setzt sie sich weiter innen fort, so dass kein gemeinsamer Schnittpunkt mit der Pontalleiste für ihren vorderen und rückwärtigen Teil im Haupthöcker entsteht, und wendet sich dann im Apikalhöcker wieder näher zur Naht; die auf

[3] Deutsche Ent. Zeitschr. (1915) 510.

ihr liegenden Höcker sind alle klein, auch der Haupthöcker. Die Humeralrippe beginnt an der Basis, wo sie sich kurz nach aussen biegt und erlischt weit vor der Pontalleiste; hinter der Schulterbeule sendet sie einen kleinen Ast nach vorne und aussen; die Pontalleiste ist in der Mitte hoch, im Haupthöcker kurz nach hinten gebogen und setzt sich als Suturalleiste, sehr wenig nach vorne gezogen, bis an die Naht fort; die Apikalleiste hat einen kurzen Ansatz innen vom Apikalhöcker; von ihren Anhängen ist nur die costa ultima lang, dagegen sind die furca interna und externa ganz kurz rudimentär. Das Seitendach ist flach ausgebreitet, breit, überall gleich dicht, grob punktiert.

Hoplionata delicatula ist, wie schon erwähnt, der *H. sexsignata* Weise, die von Surigao beschrieben wurde, sehr nahe verwandt; ich beziehe auf *sexsignata* ein von Baker erhaltenes Stück, No. 16237 meiner Sammlung, vom gleichen Fundorte. Leider hat Weise die Beschreibung der Rippenbildung so kurz gefasst, dass die Deutung meines Stückes vielleicht nicht ganz verlässlich ist. Die Zeichnung der Makeln stimmt mit der vom Autor angegebenen, nur ist die Basalmakel bei meinem Stücke nur biz zum siebenten, statt bis zum neunten Streif ausgedehnt. Von *delicatula* unterscheidet sie sich durch schmäleren, verhältnismässig längeren Umriss, längeren Halsschild, hinten weniger verengte Flügeldecken, sparsamere Grubenpunkte auf den Seitenflügeln des Halsschildes und dem Seitendache, regelmässigere, feinere Punktstreifen der Flügeldecken, abgekürzte Suturalleiste, niedrigeren Haupthöcker sammt Pontalleiste und (von rückwärts gesehen) steilen, zum Seitendache abfallenden Flügeldecken; natürlich auch durch die verschiedene Zeichnung, bei welcher besonders zu erwähnen ist dass bei *sexsignata* die mittlere Makel auf und hinter der Pontalleiste liegt, bei *delicatula* aber von dieser Leiste fast in ihrer Mitte geschnitten wird.

Hoplionota corpulenta sp. nov.

Der vorigen sehr ähnlich, so dass die Angabe der Unterschiede genügt: Höher gewölbt und nach den Seiten steiler abfallend, schmäler, mit verhältnismässig längerem Halsschild und schmälerem Seitendach der Flügeldecken; letztere haben jederseists nur eine schwarze Makel, die aber viel grösser und fast rund ist, vom dritten bis zum achten Punktstreif reicht, also innen den Haupthöcker, aussen den Humeralkiel weit überschreitet; auch nach vorne und hinten ist sie weiter ausgedehnt. Die Dorsalrippe ist niedriger, hinter dem Basalhöcker ebenfalls unterbrochen, im Haupthöcker nicht höher als gewöhnlich; die Humeralrippe

ist fast so kräftig als die Dorsal, bis zur Pontalleiste fortgesetzt; letztere fällt vom Dorsal- zum Humeralkiel viel weniger ab, ist aber niedriger als bei *delicatula;* die Apikalleiste ist sehr schwach, hat aber ihre vorderen Anhänge länger entwickelt; die Suturalleiste ist abgekürzt.

MINDANAO, Surigao (*Baker*).

Hoplionota surigaoensis sp. nov.

Von der sehr ähnlichen *H. sexsignata* Weise vor allem dadurch unterschieden, dass bei *surigaoensis* der vordere und der rückwärtige Teil des Dorsalkiels sich im Haupthöcker in einem Schnittpunkte treffen; bei *sexsignata* trifft wie bei *delicatula* der vordere Teil die Pontalleiste weiter innen als der äussere. Ferner ist *surigaoensis* kleiner und weniger gewölbt, mit viel dichteren Grubenpunkten auf Vor- und Seitendach; die vier Höcker des Dorsalkiels sind viel höher, deutlich erkennbar, der Humeralkiel an der Basis erloschen, der Dorsal in der Mitte weniger nach aussen gebogen. Auf jeder Flügeldecke sind vier pechschwarze Flecke: der erste auf der Schulterbeule, der zweite um den Basalhöcker, beide länglich; der dritte quer, auf der Pontalleiste zwischen ihren beiden Schnittpunkten, nach aussen also viel weniger weit ausgedehnt als bei *sexsignata,* der letzte hinter der Apikalleiste gross und rundlich. Grösse, 5 × 4.2 Millimeter.

Von *delicatula* und *corpulenta* ist *surigaoensis* ausser der verschiedenen Zeichnung durch schmäleren, nach hinten weniger verengten, weniger gewölbten Körper und den Schnittpunkt des Dorsalkiels verschieden.

MINDANAO, Surigao (*Baker 17034*).

BRENTHIDEN DER ENTOMOLOGISCHEN SAMMLUNG DES BUREAU OF SCIENCE, SOWIE EINIGE NEUE ARTEN AUS DER BOETTCHER'SCHEN AUSBEUTE

Von R. KLEINE

Stettin, Germany

EINE TAFEL

Herr W. Schultze, Entomologe des Bureau of Science, sandte mir das nachstehend bearbeitete Brenthidenmaterial. Das meiste sind natürlich bekannte Arten, zum Teil erst in neuester Zeit von mir beschrieben, eine kleine Anzahl ist aber neu und bringt ganz merkwürdige Formen, die im Faunengebiet noch nicht bekannt waren. Ich habe von allen Arten den Fundort mitgeteilt, da es mir für die zoogeographischen Forschungen der philippinischen Inselwelt von Wichtigkeit erscheint, die Verbreitung der einzelnen Arten genau kennen zu lernen. Der Charakter der philippinischen Brenthidenfauna scheint mir kein einheitlicher zu sein und es ist eine dankbare und interessante Aufgabe, die Beziehungen der Inseln zu einander und zu den anliegenden Gebieten, den indo- und austro-malayischen, kennen zu lernen.

CALODROMINI

Genus **CALODROMUS** Guérin-Méneville

Calodromus GUÉRIN-MÉNÉVILLE, Mag. Zool. (1832) t. 34.

Calodromus mellyi Guérin-Méneville.

Calodromus mellyi GUÉRIN-MÉNÉVILLE, Mag. Zool. (1832) t. 34.

LUZON, Ilocos Norte, Bangui (*C. S. Banks*).

Im ganzen orientalischen Gebiet, nur von Java sah ich die Art noch nicht. Auf den Philippinen schon mehrfach gefunden worden.

Genus **CYPHAGOGUS** Parry

Cyphagogus PARRY, Trans. Ent. Soc. London 5 (1849) 182.

Cyphagogus eichhorni Kirsch.

Cyphagogus eichhorni KIRSCH, Mitt. Zool. Mus. Dresden 1 (1875) 45.

NEGROS, Occidental Negros (*W. Schultze*). MINDANAO, Davao (*C. M. Weber*).

Sehr weitverbreitete Art (Assam, Molukken). Auf den Philippinen mehrfach aufgefunden.

Cyphagogus longulus Senna.

Cyphagogus longulus SENNA, Notes Leyd. Mus. 20 (1898) 52.

MINDANAO, Davao, Cabadbaran (*Weber*); Kolambugan, Lanao (*Banks*).

Von Malakka bis zu den Molukken gefunden worden. Für die Philippinen neu.

Cyphagogus tabacicola Senna.

Cyphagogus tabacicola SENNA, Bull. Soc. Ent. Ital. (1893) 294.

MINDANAO, Lanao, Kolambugan (*Banks*). LUZON, Laguna, Mount Maquiling (*C. F. Baker*).

Sehr verbreitete Art, von Indien bis zu den Philippinen in ununterbrochener Folge. Für die Philippinen neu.

Cyphagogus humilis sp. nov.

Braun, Vorderrand des Prorostrums und die Tarsen etwas heller; am ganzen Körper glänzend. Kopf gewölbt, einzeln punktiert, gegen den Hals keilförmig verengt, über den Augen keine Punktfurche. Rüssel so lang wie der Kopf, wenig verschmälert, Vorderrand flach eingebuchtet, Punktierung dichter und kräftiger als auf dem Kopfe. Drittes Fühlerglied kegelig, das vierte bis achte quadratisch oder breiter als lang, das neunte bis elfte bedeutend breiter und länger, das neunte und zehnte etwa quadratisch, das elfte stumpf-konisch, so lang wie das neunte und zehnte zusammen; Behaarung zart. Thoracalconus deutlich, Punktierung in Grösse und Tiefe wechselnd, Behaarung immer kurz, hell. Die zweite Rippe auf den Elytren in der Mitte stark verengt; Behaarung kurz. Vorderschienen mit kleinem, deutlichem Haarbüschel, Hinterschenkel an der Keule oben und unten schwach aber deutlich verengt, Metatarsus kegelig, so lang wie das zweite und dritte Glied zusammen, Klauenglied kegelig, Behaarung doppelt. Kurze Unterbehaarung mit einzelnen sehr langen Haaren vermischt. Metarostrum und Abdomen stark punktiert.

Länge (total), 5 Millimeter; Breite (Prothorax), 0.80 Millimeter, circa.

MINDANAO, Lanao, Kolambugan (*Banks*).

Es besteht eine grosse Aehnlichkeit mit *obconiceps* Senna. Die Differenzen sind folgende: Die Punktierung ist auf dem Rüssel

anders als auf dem Kopf, letzterer ist nur ganz zart, der Rüssel dagegen intensiv und dicht punktiert. Schienen der Vorderbeine mit deutlichen Haarbüscheln, der Stiel der Hinterschenkel oben und unterseits verengt, Keule kräftig, kürzer als der Stiel, Klauenglied nicht walzig, sondern kegelig.

Genus EPIGOGUS Kleine

Epigogus KLEINE, Ent. Bl. 19 (1923) 159.

Epigogus flexibilis Kleine.

Epigogus flexibilis KLEINE, Ent. Bl. 19 (1923) 159.

NEGROS, Occidental Negros, Fabrica (*Schultze*); von Negros schon bekannt.

Genus ORTHOPAREIA [1] novum

Von robuster Gestalt, einem *Glaucocephalus* ähnlich. Kopf breiter als lang, Hinterrand gerade, gewölbt, ungefurcht, Hinterecken scharfkantig, Seiten mit platten, geraden Wangen, ungezähnt, Unterseite an der Basis keilförmig vertieft; Augen klein, vorgerückt. Rüssel sehr kurz, Metarostrum oberseits schmäler als der Kopf, gefurcht, Mesorostrum erweitert, gefurcht, Prorostrum an der Basis stark verengt, nach dem Vorderrand erweitert, im schmalen Teil gefurcht, Vorderrand in der Mitte flach eingebuchtet; Mandibeln dem Vorderrand anliegend, klobig. Fühler bis auf die Mitte des Prothorax reichend, das erste Glied gross, das zweite ohne Stiel, etwas breiter als lang, das dritte kegelig, länger als breit, das vierte bis achte quadratisch, das neunte vergrössert, das neunte länger als breit, Basis gerundet, Vorderrand gerade, das zehnte kürzer, von gleicher Gestalt, das elfte stumpf-konisch, so lang wie das neunte und zehnte zusammen, Behaarung mittelstark, das neunte bis elfte Glied mit kurzer Unterbehaarung. Prothorax gedrungen, eiförmig-elliptisch, grösste Breite hinter der Mitte, gewölbt, in den basalen zwei Dritteln tief gefurcht, am Halse seitlich stark verengt, oberseits durch einen breiten Quereindruck vom Halse getrennt. Elytren breit, Basis flach schräg, Seiten gerade, Hinterrand in einer stumpfen, mittleren Spitze endigend; Sutura breit, parallel, die zweite Rippe schmal, in der Mitte lang unterbrochen, die dritte sehr breit und flach, auf dem Absturz verschmälert und erhöht, die vierte schmal, die fünfte breit, die sechste schmal, die siebente bis zehnte breit, Furchen so breit wie die schmäleren Rippen. Beine gedrungen, Vorderschenkel

[1] *ὀρθός*, gerade; *παρειά*, Wange.

sehr breit, Schienen lang-keilförmig, normal gedornt, Tarsen normal, Mittelbeine zart, den vorderen ähnlich, Hinterschenkel nicht über die Elytren hinausragend, Keule mässig dick, Schienen lang-dreieckig, Metatarsus so lang wie das zweite und dritte Glied zusammen, Klauenglied zart, keulig. Metasternum, erstes und zweites Abdominalsegment zart längsgefurcht, Quernaht nur an den Seiten deutlich.

Genotypus, *Orthopareia idonea* sp. nov.

Die Gattung ist in die Nähe von *Callipareius* Senna zu bringen, von der sie sich durch folgende Merkmale leicht unterscheiden lässt: Die Gestalt ist nicht schlank, sondern auffällig gedrungen und sieht einem *Glaucocephalus* sehr ähnlich. Kopf und Fühler sind *Callipareius* ähnlich. Der Prothorax ist nicht schlank, sondern sehr gedrungen und, mit Ausnahme des vorderen Drittels, tief gefurcht. Die Elytren sind gleichfalls sehr gedrungen, durch die wechselnde Stärke der Rippen und der weit unterbrochenen zweiten Rippe gekennzeichnet. *Callipareius* ist von schlanker, *Orthopareia* von gedrungener Gestalt; die Verwandtschaft liegt in der Form von Kopf und Rüssel. Die neue Gattung hat sich unmittelbar *Callipareius* anzuschliessen.

Orthopareia idonea sp. nov.

Kastanienbraun in wechselnder Tiefe. Kopf und Rüssel einzeln punktiert, Unterseite punktiert und borstig behaart. Prothorax neben der Furche und auf den Aussenkanten punktiert und kräftig behaart, seitlich bis zu den Hüften reichend. Elytren mit punktierten und behaarten Rippen. Beine, namentlich die Schenkel, stark behaart. Metasternum kaum sichtbar punktiert, in der Mittelfurche zottig behaart. Das erste und zweite Abdominalsegment seitlich querfurchig, Punktierung gering, nur an der Basis des ersten Segments behaart, das dritte bis fünfte Segment dicht punktiert, das fünfte sehr dicht.

Länge (total), 7 Millimeter; Breite (Prothorax), 1.5 Millimeter.

LUZON (*Webb*).

Genus **OPISTHENOXYS** Kleine

Opisthenoxys KLEINE, Arch. Nat. A 10, 87 (1921) 26.

Opisthenoxys ochraceus Kleine.

Opisthenoxys ochraceus KLEINE, Arch. Nat. A 10, 87 (1921) 28.

NEGROS, Occidental Negros, Fabrica (*Schultze*).

Auf den Philippinen sehr häufig. Die vorliegenden Individuen waren in Grösse und Färbung sehr variabel.

Opisthenoxys boettcheri sp. nov.

Männchen.—Hellgelbbraun bis kastanienbraun, nur die Elytren auf der Mitte mit einer dunklen Makel, die nicht über die sechste Rippe hinausgeht; mit Ausnahme der angegebenen Organe stark glänzend. Kopf tief dreieckig eingekerbt, die Hinterecken gegen den Hals etwas vorstehend, matt, grob skulptiert und dicht, kurz beborstet; Augen gross, am hinteren Augenrand einige kurze Borsten. Meta- und Mesorostrum gefurcht, wie der Kopf skulptiert, Prorostrum schlank, glänzend, nadelstichig punktiert und kurz behaart. Das zweite Fühlerglied länger als das dritte, das dritte bis achte perlig, gleichlang, das neunte bis elfte vergrössert, platt, das elfte kürzer als das neunte und zehnte zusammen. Prothorax platt, am Halse oberseits und seitlich eingedrückt, Punktierung sehr zart und zerstreut, nur am Hinterrand und in den Vertiefungen am Halse grob punktiert und kurz behaart. Elytren von normaler Gestalt, erste bis dritte Rippe breiter als die folgenden, auf den Rippen entferntstehend beborstet, Gitterung deutlich. Beine ohne besondere Merkmale.

Länge (total), 3.5 bis 4 Millimeter; Breite (Prothorax), 0.75 Millimeter, circa.

MINDANAO, Point Banga (*Böttcher*).

Holotypus im Dresdener Museum, Paratypus in meinem Besitz.

Von *ochraceus* trennen die anders geformten Fühler. Bei jener Art ist das dritte Fühlerglied immer länger als das zweite und vierte bis achte, hier ist das zweite das längste. Von allen bekannten Arten trennt die Form des Kopfes und die starke Beborstung desselben.

Genus **ATOPOMORPHUS** [2] novum

Von gedrungener Gestalt. Kopf viel breiter als lang, Hinterrand flach nach innen gebuchtet, platt, hinten und seitlich scharfkantig, Unterseite backenartig erhöht, mit flacher Mittelfurche, Augen gross, fast den ganzen seitlichen Kopf einnehmend, prominent. Rüssel so breit wie der Kopf und von demselben nicht getrennt, eine platte, zusammenhängende, fast parallele, gebogene Ebene bildend, keine Furchen, Vorderrand

[2] ἄτοπος, curios; μορφή, Gestalt.

flach nach innen gebuchtet; Mandibeln klein, ganz unter dem Vorderrand des Prorostrums verborgen. Das erste Fühlerglied walzig, das zweite und vierte bis achte quer, perlig, das dritte kegelig, etwas länger als breit, das neunte bis elfte vergrössert, das neunte kleiner als das zehnte. Das neunte etwa quadratisch, das zehnte länger als breit, das elfte stumpf-konisch, kaum so lang wie das neunte und zehnte zusammen. Prothorax eiförmig, grösste Breite im hinteren Drittel, gegen den Hals stark verengt, Oberseite gewölbt, ungefurcht. Elytren gedrungen, seitlich fast parallel, gegen den Absturz rundlich verschmälert, gemeinsam abgerundet, gerippt gefurcht. Die erste und zweite Rippe breiter als die folgenden, die unter sich alle gleich breit sind, alle Rippen platt, Furchen so breit wie die Rippen glatt, unpunktiert. Vorderbeine kurz, Schenkel breit, Schienen und Tarsen normal, Mittelbeine schlank, Hinterschenkel kaum über die Elytren reichend, Stiel schlank, Keule kräftig, Schienen nach innen blattartig erweitert, Metatarsus so lang wie das zweite und dritte Glied, Klauenglied zart, keulig.

Genotypus, *A. schultzei* sp. nov.

Habituell besteht einige Aehnlichkeit mit der Gattung *Dyscheromorphus* Kleine, die durch die anders geformten Schienen in eine ganz andere Verwandtschaft gehört. Die Gestalt ist ameisenartig. Der Kopf ist mit dem Rüssel einheitlich verbunden, so dass oberhalb keine Trennung dieser beiden Organe erkennbar ist. Die Fühler sind in grossen, den vorderen Teil des Rüssels einnehmenden Gruben eingefügt. In meiner Bestimmungstabelle kommt man zu *Adidactus* Senna, mit der keinerlei Beziehungen bestehen, ausgenommen die erweiterten Hinterschienen. Es liegt also in *Atopomorphus* ein intermediärer Typus vor.

Atopomorphus schultzei sp. nov. Tafel 1, Fig. 1, 2, und 3.

Kastanienbraun, glänzend. Kopf an der Basis grob, der übrige Teil und der Rüssel zart aber dicht punktiert, Kopf borstig behaart, Rüsselvorderrand mit einzelnen zarten Härchen, seitliche Behaarung (Tafel 1, Fig. 1). Fühler seidig, mittellang behaart. Unterbehaarung des neunten und elften Gliedes gering. Prothorax auf der Oberseite grob aber zerstreut punktiert, in den Punkten zart behaart, nach den Seiten lässt die Skulptur nach, Prosternum unpunktiert. Elytren auf den Rippen weitläufig punktiert, in den Punkten abstehend behaart. Beine ganz allgemein nur zerstreut behaart.

Länge (total), 4 Millimeter; Breite (Prothorax), 1 Millimeter, circa.

NEGROS, Occidental Negros, Fabrica (*Schultze*).

Sammler, W. Schultze, dem ich dies interessante Tier widme.

STEREODERMINI

Genus **CEROBATES** Schoenherr

Cerobates SCHOENHERR, Gen. Curc. 5 (1840) 487.

Cerobates tristriatus Fabricius.

Cerobates tristriatus FABRICIUS, Syst. El. 2 (1801) 554.

LUZON, Laguna, Magdalena (*Schultze*); Ilocos Norte, Bangui, (*Banks*). MINDANAO, Davao, Cabadbaran (*Weber*).

Im ganzen orientalischen Gebiet in starker Variation verbreitet.

TRACHELIZINI

Genus **HOMOPHYLUS** Kleine

Homophylus KLEINE, Zool. Meded. Leyden 4[5] (1920) 244.

Homophylus mindanensis sp. nov.

Männchen.—Rotbraun, Halsrand, Rüsselseiten und eine postmediane Makel dunkel, am ganzen Körper hochglänzend. Kopf sehr zart und zerstreut punktiert, mit sehr schwacher, flacher Mittelfurche, zwischen den Augen grubig vertieft, Hinterrand und Unterrand bis zum mittleren Auge filzig. Meta- und Mesorostrum kräftig gefurcht, Prorostrum in der basalen Hälfte platt, Punktierung kräftiger als auf dem Kopf. Fühler normal. Prothorax desgleichen. Elytren auser der Sutura nur mit einer schmalen, durchgehenden Rippe, nur auf dem Absturz Rudimente weiterer Rippen, die durch grobe, filzige Punkte getrennt sind, jede weitere Punktierung fehlt. Metatarsus aller Beine nicht länger als das zweite Glied.

Länge (total), 6.5 Millimeter; Breite (Prothorax), 1 Millimeter, circa.

MINDANAO, Surigao (*Böttcher*).

Holotypus im Dresdener Museum.

Die Gattung kommt also nicht nur in Java vor. Die am nächsten stehende Art ist *durus* Kleine, die Unterschiede sind folgende: Die Rippenrudimente finden sich nicht an der Basis, sondern auf dem Absturz, jede Reihenpunktierung fehlt, die Elytren sind spiegelglatt. Der Metatarsus aller Beine ist nicht länger als das zweite Glied.

Genus **TRACHELIZUS** Schoenherr

Trachelizus SCHOENHERR, Gen. Curc. 5 (1840) 489.

Trachelizus bisulcatus Fabricius.

Trachelizus bisulcatus FABRICIUS, Syst. El. 2 (1801) 548.

MINDANAO, Davao, Cabadbaran (*Weber*).
Gemein von Ostindien bis zur Ostküste Australiens.

Genus **MIOLISPA** Pascoe

Miolispa PASCOE, Journ. Ent. 1 (1862) 393.

Miolispa bicolor Kleine.

Miolispa bicolor KLEINE, Stett. Ent. Ztg. 80 (1919) 316.

LUZON, Nueva Vizcaya, Imugan (*Banks*).
Nur von den Philippinen bekannt geworden.

Miolispa unicolor Kleine.

Miolispa unicolor KLEINE, Stett. Ent. Ztg. 80 (1919) 314.

LUZON, Nueva Vizcaya, Imugan (*Banks*).
Nur von den Philippinen bekannt.

Miolispa pulchella Kleine.

Miolispa pulchella KLEINE, Arch. Nat. A 10, 87 (1921) 29.

LUZON, Nueva Vizcaya, Imugan (*Banks*).
Nur von Luzon bekannt.

Miolispa fornicata Kleine.

Miolispa fornicata KLEINE, Ent. Bl. 19 (1923) 161.

Von dieser Art lagen mir circa 20 Exemplare aus der Böttcher'schen Ausbeute vor, alle vom gleichen Fundort. Es zeigte sich, dass die Variabilität eine ganz auffällig grosse war. Die braune Körperfarbe kann gänzlich schwarz werden, nur die dritte Rippe bleibt gelb. Der Prothorax ist von sehr wechselnder Gestalt, schlank eiförmig bis breit-elliptisch in allen Uebergängen. Auch die Punktierung ist recht wechselnd, kann sehr ansehnlich sein, aber bis auf eine Punktreihe am Hinterrand ganz zurückgehen. Es kommen Exemplare mit mehr oder weniger rotem Prothorax vor. Ein wichtiges diagnostisches Merkmal hat sich noch ergeben, das der Type fehlt: die Elytren sind einzeln aber ansehnlich behaart, die Behaarung ist aber, wie es scheint, recht hinfällig. Spuren von Behaarung waren immer noch nachweisbar.

Miolispa clavicornis Kleine.

Miolispa clavicornis KLEINE, Arch. Nat. A 10, 87 (1921) 30.

Es kommen dieselben Variationen wie bei *fornicata* vor.

AMORPHOCEPHALINI

Genus **LEPTAMORPHOCEPHALUS** Kleine

Leptamorphocephalus KLEINE, Arch. Nat. A 12, 82 1916 (1918) 132.

Leptamorphocephalus sumatranus Senna.

Leptamorphocephalus sumatranus SENNA, Notes Leyd. Mus. 16 (1894) 195.

PALAWAN, Silanga (*E. D. Merrill*).

Das Auffinden dieser Art auf Palawan bestätigt meine schon früher geäusserte Ansicht, dass diese Insel mit den Philippinen nichts gemein hat und dem grossen asiatischen Landmassiv angehört. Auf den Philippinen kommt die Art nicht mehr vor.

Genus **PARAMORPHOCEPHALUS** Kleine

Paramorphocephalus KLEINE, Zool. Meded. Leyden 4 (1920) 236.

Paramorphocephalus setosus sp. nov. Tafel 1, Fig. 4.

Weibchen.—Rotbraun, Prorostrum, Fühler, Halsrand, Schenkel, und Schienen an Basis und Spitze in mehr oder weniger grossem Umfang und die Tarsen schwärzlich, Glanz mittelstark, Prothorax und Elytren matt. Kopf quer, drei- bis viermal so breit als lang, mit schmaler, flach nach innen abschüssiger Mittelfurche, überall mit einzelnen langen, nach vorngerichteten, in Poren stehenden Haaren besetzt; Augen seitlich prominent; Unterseite mit einzelnen kurzen, anliegenden Haaren besetzt. Metarostrum schildförmig (Tafel 1, Fig. 4), steil ansteigend, an den Seitenrändern mit tiefen Poren, in denen nach vorn kurze, nach hinten zu lange Haare stehen, sonst nur sehr schwach skulptiert, Prorostrum rundlich-walzig, kräftig punktiert, Unterseite mit einzelnen Poren. Fühler nodos, vom dritten bis achten etwas kürzer werdend, neunte und zehnte wieder länger, tonnenförmig, elfte walzig, so lang wie das neunte und zehnte zusammen, erste bis achte einzeln lang beborstet, neunte bis elfte dicht, kurz behaart. Prothorax kurz, walzig, mit einzelnen grossen Poren, die auf der Oberseite lang behaart sind. Elytren glatt, Rippen und Furchen nur durch einzelne Poren angedeutet, in den Rippenporen mit langen Haaren besetzt.

Beine normal, keine Verbreiterung der Schenkelstiele, mit Ausnahme der Tarsen einzeln punktiert und in den Punkten lang behaart. Metasternum an der Basis schmal gefurcht, Abdomen ungefurcht, Punktierung überall einzeln aber kräftig, Behaarung kurz, anliegend.

Länge (total), 10 Millimeter; Breite (Prothorax), 2 Millimeter.

SAMAR (*Baker*).

Allotypus im Dresdener Museum.

Die Ausfärbung ist sehr hell, es liegt ohne Zweifel ein unreifes Exemplar vor, die normale Farbe dürfte, wie bei allen anderen Arten, violettbraun sein. Von allen anderen Arten kommt *diabolus* Kleine als nächstverwandte Art allein in Frage, nur damit ist *setosus* zu vergleichen; *diabolus* unterscheidet sich folgendermassen: Der Kopf hat keine schmale Mittelfurche, das Schild des Metarostrums ist von ganz anderer Form und auf dem Diskus mit Exsudatgruben besetzt. Die Fühler sind weniger stark nodos. Der Schenkelstiel ist bei *diabolus* weniger schmäler als die Keule, bei *setosus* dagegen schmal, stielartig. Der Begattungsapparat wird die Artsicherheit bestätigen, leider lag kein Mann vor.

ARRHENODINI

Genus **AGRIORRHYNCHUS** Power

Agriorrhynchus POWER, Pet. Nouv. Ent. 2 (1878) 241.

Agriorrhynchus ignarus sp. nov. Tafel 1, Fig. 5, 6, und 7.

Rotbraun, Kanten an Kopf, Rüssel, und Fühlern, Halsrand des Prothorax, Schenkel und Schienen an Basis und Spitze schwarz, Prothorax an den Seiten mit dunklen, unscharfen Längsstreifen, am ganzen Körper hoch glänzend. Kopf keilförmig, Punktierung sehr fein und zerstreut, Zahnung des Rüssels in Seitenansicht (Tafel 1, Fig. 5). Fühler robust, das erste Glied krugförmig, das zweite bis neunte breiter als lang, nach vorn an Breite ab- und an Länge zunehmend, Hinterkanten gerundet, Vorderkanten scharf, das zehnte quadratisch, beiderseits scharfkantig, das elfte konisch, länger als das neunte und zehnte zusammen, basale Glieder ganz unbehaart, nach vorn zu an Behaarung zunehmend, das zehnte und elfte mit dichter Unterbehaarung. Prothorax ohne sichtbare Punktierung, die im hinteren Drittel liegenden groben punktartigen Vertiefungen sehr flach. Elytren normal, Schmuckzeichnung wie in Tafel 1, Fig.

6. Beine normal. Metasternum gefurcht, fast unpunktiert. Das erste und zweite Abdominalsegment flach vertieft, keine Skulptur auf allen Segmenten.

Länge (total), 2.2 Millimeter; Breite (Prothorax), 4.5.

LUZON, Laguna, Los Baños, 23ter März, 1915 (*Banks*).

Die neue Art sieht *quadrituberculatus* Senna ähnlich, unterscheidet sich durch die Behaarung des Rüssels, durch andere Anordnung der Schmuckzeichnung der Elytren und den gänzlich andern Penis.

Es ist sehr interessant, dass die Gattung bis zu den Philippinen vorgedrungen ist, denn bisher waren zwei Arten von den Sundainseln und eine von Burma bekannt. Im Penisbau besteht grössere Anlehnung an *undulatus* Power, der *ignarus* sonst aber nicht ähnlich ist. Die Festlegung der *Agriorrhynchus*-Arten stösst auf keine Schwierigkeit; das Gattungsbild wird durch *ignarus* nicht beeinträchtigt, im Gegenteil, eher vertieft.

Genus **EUPEITHES** Senna

Eupeithes SENNA, Ann. Mus. Civ. Stor. Nat. Gen. (2) 19 (39) (1898) 381.

Eupeithes dominator Kleine.

Eupeithes dominator KLEINE, Ent. Bl. 17 (1921) 7/9 125.

SAMAR, Wright (*R. C. McGregor*).

Von dieser schönen Art fand ich auch das Weibchen vor. Die Differenzen gegen den Mann sind die üblichen. Die Vorderbeine waren mässig vergrössert. Nur von den Philippinen bekannt.

Genus **PROPHTHALMUS** Lacordaire

Prophthalmus LACORDAIRE, Gen. Col. 7 (1866) 427.

Prophthalmus longirostris Gyllenhal.

Prophthalmus longirostris GYLLENHAL, in Schoenh. Gen. Curc. 1 (1833) 323.

MINDANAO, Davao, Cabadbaran River (*Weber*), Davao (*Weber*).

Leider stand kein Männchen zur Verfügung. Ich kann das Tier nur zu *longirostris* bringen, es kommt keine andere Art in Frage; die Verbreitung ist über Java bis Celebes festgestellt. Es ist sehr naheliegend, dass auch die Philippinen bewohnt sind, umsomehr, als der sehr ähnliche *assimilis* in Tonkin und Süd China gefunden worden ist.

Prophthalmus tricolor Power.

Prophthalmus tricolor POWER, Ann. Soc. Ent. Fr. V 8 (1878) 38.

MINDANAO, Davao, Cabadbaran River (*Weber*); Butuan, Agusan (*Weber*). BOHOL (M. Ramos).

Alle Exemplare gehören der forma *philippinensis* an.

Genus **BARYRRHYNCHUS** Lacordaire

Baryrrhynchus LACORDAIRE, Gen. Col. 7 (1866) 428.

Baryrrhynchus schroederi Kleine.

Eupsalomimus schroederi KLEINE, Stett. Ent. Ztg. (1914) 172.

MINDANAO, Butuan, Agusan River (*Weber*); Lanao, Kolambugan (*Banks*); schon bekannt.

Genus **AMPHICORDUS** Heller

Amphicordus HELLER, Philip. Journ. Sci. § D 8 (1913) 151.

Amphicordus improportionalis Heller.

Amphicordus improportionalis HELLER, Philip. Journ. Sci. § D 8 (1913) 152.

MINDANAO, Lanao, Kolambugan (*Banks*).

Die wenigen bekannt gewordenen Stücke stammen alle von Mindanao.

Genus **CAENORYCHODES** Kleine

Caenorychodes KLEINE, Arch. Nat. A 9, 86 (1920) 87.

Caenorychodes serrirostris Fabricius.

Caenorychodes serrirostris FABRICIUS, Syst. El. 2 (1801) 553.

MINDANAO, Butuan, Agusan River (*Weber*).

Diese häufige und weit verbreitete Art ist auch auf den Philippinen nicht selten.

Genus **PSEUDORYCHODES** Senna

Pseudorychodes SENNA, Ann. Soc. Ent. Belg. 38 (1894) 375.

Pseudorychodes praeclarus sp. nov. Tafel 1, Fig. 8.

Männchen.—Kastanienbraun, Halsring des Prothorax, Kanten des Rüssels und Vorderkanten der Fühlerglieder und die Schenkel an der Basis verdunkelt; am ganzen Körper hochglänzend. Kopf gewölbt, breiter als lang, ungefurcht, einzeln aber sehr deutlich punktiert, Unterseite mit einer Reihe weitstehender, zarter Punkte in welchen ein längeres, anliegendes Haar steht.

Metasternum lang-elliptisch, muldenförmig, ausgehöhlt, Mesorostrum normal erweitert, gewölbt, flach gefurcht, Prorostrum jederseits mit entferntstehenden Dornen, Punktierung auf dem Meta- und Mesorostrum wie auf dem Kopf, Prorostrum mit warzigen Erhebungen. Fühler normal. Prothorax eiförmig mit sehr feiner, zerstreuter Punktierung. Elytren am Absturz gerundet, die siebente Rippe im hinteren Drittel mit zwei entferntstehenden Punkten, in jedem Punkt ein kräftiges, abstehendes Haar; Schmuckzeichnung, Tafel 1, Fig. 8. Beine normal. Metasternum und Abdomen gefurcht, Skulptur äusserst zart, ersteres an den Seiten mit einer Reihe grosser, tiefer Punkte.

Länge (total), 10 Millimeter; Breite (Prothorax), 1.75.

MINDANAO, Surigao (*Böttcher*).

Holotypus im Dresdener Museum.

Die nächstverwandte Art dürfte *fruhstorferi* Senna sein. Sie ist die einzige Art, die basal auf der dritten und fünften Rippe Schmuckzeichnung hat. Abgesehen von diesem übereinstimmenden Merkmal sind die Anlagen der Elytrenzeichnung bei beiden Arten sehr verschieden. Weitere Differenzen gegen *fruhstorferi:* Kopf nicht gefurcht, das vierte bis achte Fühlerglied länger als breit, Prothorax ohne jede Querrunzelung.

BELOPHERINI

Genus **HENARRHENODES** Heller

Henarrhenodes HELLER, Philip. Journ. Sci. § D 8 (1913) 152.

Henarrhenodes macgregori Heller.

Henarrhenodes macgregori HELLER, Philip. Journ. Sci. § D 8 (1913) 153.

LUZON, Benguet, Irisan River (*McGregor*).

Diese prachtvolle Art ist nur von den Philippinen bekannt, scheint aber ziemlich verbreitet zu sein.

Genus **ECTOCEMUS** Pascoe

Ectocemus PASCOE, Journ. Ent. 1 (1862) 388.

Ectocemus badeni Kirsch.

Ectocemus badeni KIRSCH, Mitt. Zool. Mus. Dresden 1 (1875) 48.

MINDANAO, Lanao, Kolambugan (*Banks*).

Auf den Philippinen nicht selten, ich sah sie auch von Celebes. Die Anordnung der Schmuckzeichnung lässt auch darauf schliessen, dass die Art mit den Molukkentieren und nicht mit den Asiaten verwandt ist.

Genus **APOCEMUS** Calabresi

Apocemus CALABRESI, Bull. Soc. Ent. Ital. (II et III) 53 (1921) 58.

Apocemis ignobilis sp. nov. Tafel 1, Fig. 9.

Weibchen.—Blauschwarz, Prothorax kirschrot, vordere Hälfte schwärzlich, Metasternum und Abdomen kirschrot, letzteres in der Mittelfurche und Quernaht dunkler, am ganzen Körper hoch glänzend. Kopf gewölbt, ungefurcht, Unterseite glatt, ohne Skulptur. Metarostrum in der vorderen Hälfte gefurcht, oberseits überall mit kraterähnlichen Punkten, Seiten mit einigen grossen, tiefen Punkten, Unterseite am Mesorostrum flach, quer gerunzelt, Mesorostrum länger als breit, in der basalen Hälfte mit kräftiger Mittelfurche, die in der vorderen Hälfte ganz flach ist, Skulptur wie auf dem Metarostrum; Prorostrum fadenförmig, in der basalen Hälfte mit einzelnen, schmalen, langelliptischen Erhöhungen, auf denen ein kraterähnlicher Punkt steht, vordere Hälfte einzeln, zart punktiert. Das erste Fühlerglied keulig, das zweite etwas kürzer als das erste, das dritte kürzer als das zweite, das kürzeste von allen, das vierte so lang wie das zweite und dritte zusammen, bis zum siebenten an Länge zunehmend, das achte bis zehnte gleichlang, das elfte verlängert, das zweite bis sechste an der Spitze nodos verdickt, vom fünften ab behaart, die Behaarung nach den vorderen Gliedern an Dichte zunehmend. Prothorax auf der Mitte mit lang-elliptischem, mattem, quergerunzeltem Fleck, sonst ohne Skulptur. Elytren normal. Beine desgleichen. Metasternum und Abdomen einzeln, zerstreut punktiert, ersteres in der Mitte einzeln behaart.

Länge (total), 21 Millimeter; Breite (Prothorax), 3.

LUZON, Bataan, Lamao (*W. D. Carpenter*).

Obgleich nur ein weibliches Tier vorliegt, besteht doch kein Zweifel dass die Art zu *Apocemus* gehört. Bisher ist nur *conciliator* Kirsch von Malakka bekannt.

Es ist möglich, dass sich auf der dritten Rippe apical ein mehr oder weniger langer roter Streifen bilden kann; das mir vorliegende Tier hatte nur einen kleinen roten Punkt. Die reduzierte, langstreifige Schmuckzeichnung ist für die Philippinen-Fauna charakteristisch.

ITHYSTENINI

Genus **HETEROPLITES** Lacordaire

Heteroplites LACORDAIRE, Gen. Col. 7 (1866) 471.

Heteroplites erythroderes Boheman.

Heteroplites erythroderes Boheman, SCHOENHERR, Gen. Curc. 5 (1840) 564.

LUZON, Ilocos Norte, Bangui (*Banks*): Nueva Vizcaya, Imugan.

Nur von den Philippinen bekannt.

Heteroplites spinifer Kleine.

Heteroplites spinifer KLEINE, Arch. Nat. A 10, 87 (1921) 36.

POLILLO (*McGregor*). BOHOL, Bilar (*Ramos*).

Nur von den Philippinen bekannt.

Genus **DIURUS** Pascoe

Diurus PASCOE, Journ. Ent. 1 (1862) 392.

Diurus furcillatus Gyllenhal.

Diurus furcillatus GYLLENHAL, SCHOENHERR, Gen. Curc. 1 (1833) 359.

LUZON, Ilocos Norte, Bangui (*Banks*). MINDANAO, Davao, Davao (*Weber*). MINDORO, Baco River (*McGregor*).

Weit verbreitete, häufige Art, von den Philippinen schon bekannt.

PSEUDOCEOCEPHALINI

Genus **HORMOCERUS** Schoenherr

Hormocerus SCHOENHERR, Curc. Disp. (1826) 70.

Hormocerus reticulatus Fabricius.

Hormocerus reticulatus FABRICIUS, Syst. El. 2 (1801) 552.

MINDANAO, Davao, Davao (*Weber*). BORNEO, Sandakan (*J. E. Wahr*).

Gemein von Ceylon bis zur Ostküste Australiens.

Genus **SCHIZOTRACHELUS** Lacordaire

Schizotrachelus LACORDAIRE, Gen. Col. 7 (1866) 454.

Schizotrachelus bakeri Kleine.

Schizotrachelus bakeri KLEINE, Arch. Nat. A 10, 87 (1921) 33.

NEGROS, Occidental Negros, Fabrica (*Schultze*).

Nur von den Philippinen bekannt.

Schizotrachelus imitator sp. nov. Tafel 1, Fig. 10 und 11.

Dem *Schizotrachelus angulaticeps* Senna habituell gleich, durch folgende Merkmale unterschieden: Auf den Elytren fehlt der neben der Sutura liegenden helle Streifen. Der Kopf ist seitlich parallel, nicht gegen den Rüssel verengt, die Augen stehen mehr vor. Das Metarostrum ist breit und tiefgefurcht, das Prorostrum ohne Furche, während bei *angulaticeps* das Metarostrum schmäler gefurcht ist und dem Prorostrum, wenigstens in der

basalen Hälfte, niemals die Furche fehlt. Fühler gedrungen (Tafel 1, Fig. 10), die Glieder niemals perlig oder gar länger als breit. Prothorax gänzlich unpunktiert, auch über den Hüften fehlen die Punkte. Hinterschienen schmal, im Gegensatz zu den sehr breiten Schienen bei *angulaticeps*. Paramerenlamellen lang, bei *angulaticeps* kurz.

Länge, Männchen, Weibchen (total), 10 bis 19 Millimeter; Breite (Prothorax), 1.2 bis 2 Millimeter.

LUZON, Burauen, Balbalason, San Miguel. POLILLO. LEYTE. PANAON. CAMIGUIN. CATANDUANES, Vivac.

Sieben Männchen, 8 Weibchen (*Böttcher*).

Holo- und Allotypus im Dresdener Museum.

Von Mindoro, St. Theodora, sah ich mehrere Stücke von hellkastanienbrauner Farbe, die sich habituell von *imitator* nicht unterscheiden. Der Begattungsapparat stimmt in allen untersuchten Exemplaren überein. Ich unterlasse eine Benennung, da es sich wahrscheinlich nur um immature Stücke handelt.

Schizotrachelus imbricellus sp. nov.

Männchen.—Einfarbig schwarz, mit schwachem Metallglanz, am ganzen Körper hochglänzend. Kopf oblong, länger als breit, Seiten flach parallel, am Hinterrand schwach verengt, Oberseite gewölbt, Hinterrand breit und tief dreieckig eingekerbt, die Einkerbung in eine kräftige kurze Einkerbung fortgesetzt, die mit der zwischen den Augen beginnenden Rüsselfurche in keiner Verbindung steht, Punktierung einzeln, zerstreut; Seiten und Unterseite gleich skulptiert, letztere am Hinterrand und ein schmaler Längsstreifen matt, chagriniert. Metarostrum kürzer als das Prorostrum, gegen das Mesorostrum etwas verschmälert, flach gefurcht, Oberseite matt, seitlich mit einigen matten Flecken, die vom Kopf kommende matte Mittelfurche setzt sich auf das Metarostrum fort; Mesorostrum flach, Mittelfurche in der basalen Hälfte schmal, in der vorderen breiter werdend, Punktierung einzeln, Prorostrum gegen den Vorderrand schwach erweitert, in den basalen zwei Dritteln gefurcht, Punktierung am Vorderrand dichter, Vorderrand tief eingebuchtet. Fühler kurz, zart, das zweite und vierte bis zehnte Glied perlig, das elfte konisch, so lang wie das neunte und zehnte zusammen, Behaarung zart und einzeln, das neunte und zehnte Glied nur in der vorderen Hälfte dicht und grubig skulptiert. Prothorax schlank, Punktierung in der basalen Hälfte gross und grob, zum Teil filzig, nach vorn nimmt die Punktierung ab und verschwindet ganz. Elytren parallel, an den Seiten sind die erste,

zweite, und vierte Rippe obsolet, die anderen erhöht, Hinterecken stumpflich gerundet, Hinterrand neben der Sutura flach aber deutlich nach innen gebuchtet, die achte Rippe am Absturz stark verdickt, Punktierung sehr gross und einzeln. Hinterschienen verbreitert, Beine sonst normal. Metasternum nur an der Basis kurz und flach gefurcht, an den Seiten mit einer groben Punktreihe, das erste und zweite Abdominalsegment kräftig gefurcht, Skulptur wie auf dem Metasternum.

Länge (total), 11 Millimeter; Breite (Prothorax), 1.2 Millimeter.

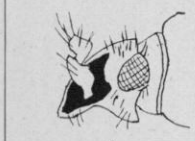
LUZON, Laguna, Mount Banahao.

In meiner Bestimmungstabelle kommt man zu *angulaticeps* und *imitator*, von denen der tiefpunktierte Prothorax, die grobpunktierten Elytren, die am Absturz stark verdickte achte Rippe, und die an der Basis zum Teil obsoleten Rippen trennen. Die Paramerenlamellen sind schmal und sehr lang.

ILLUSTRATIONEN

TAFEL 1

FIG. 1. *Atopomorphus schultzei* sp. nov., Kopf in Seitenansicht.
2. *Atopomorphus schultzei* sp. nov.; Kopf in Ansicht von oben.
3. *Atopomorphus schultzei* sp. nov.; Hinterschiene in Ansicht von hinten und von der Seite.
4. *Paramorphocephalus setosus* sp. nov.; Kopf und Metarostrum.
5. *Agriorrhynchus ignarus* sp. nov.; Rüssel in Seitenansicht.
6. *Agriorrhynchus ignarus* sp. nov.; Elytrenzeichnung.
7. *Agriorrhynchus ignarus* sp. nov.; Parameren.
8. *Pseudorychodes praeclarus* sp. nov.; Schmuckzeichnung.
9. *Apocemis ignobilis* sp. nov.; Elytrenzeichnung.
10. *Schizotrachelus imitator* sp. nov.; Fühler.
11. *Schizotrachelus imitator* sp. nov.; Parameren.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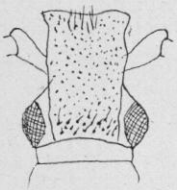
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TAFEL 1.

DESCRIPTION DE TROIS ESPÈCES NOUVELLES DE GALERUCINI DES PHILIPPINES

Par V. LABOISSIÈRE

Levallois-Perret (Seine), France

AVEC UNE FIGURE DE TEXTE

Oides bakeri sp. nov. Fig. 1.

En ovale court. Entierèment jaune ferrugineux brillant, plus pâle sur la tête, le pronotum et les antennes; yeux et sommets des mandibules noirs.

Labre étroitement mais profondément échancré, épistôme surmonté d'une carène large, convexe, se soudant à son sommet aux calus surantennaires; ceux ci petits, transversaux et limités en dessus par un sillon droit, coupé dans son milieu par une légère fossette, continuée par un fin sillon coupant le vertex. Antennes allongées atteignant la moitié des élytres, les troisième et quatrième articles égaux; les articles 7 á 9 un peu plus épais.

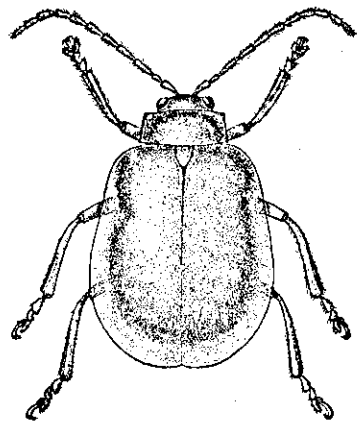

FIG. 1. *Oides bakeri* sp. nov.

Pronotum transversal, environ deux fois plus large que long; bords latéraux droits et parallèles, bord antérieur légèrement élevé sur son milieu, assez fortement échancré, et parallèle à la base qui est arquée; les angles antérieurs sont droits, émoussés; les postérieurs obtus. Surface convexe, lisse, sans trace d'impression. Ecusson triangulaire, allongé, arrondi au sommet.

Elytres bien plus larges que le pronotum à la base, fortement élargis et arrondis en arrière; très amples et convexes, ils sont fortement impressionnés sur le côté vers le premier tiers, leur surface est marquée d'une ponctuation extrèmement fine, un court sillon longe la suture en arrière de l'écusson; les épipleu-

res sont courts, situés à la hauteur du bord latéral à leur base, ils se contournent et s'en éloignent vers la moitié de leur longueur.

Dessous ferrugineux. Prosternum très étroit mais visible entre les hanches. Longueur, 7.75 á 8.5 millimètres; largeur, 5 á 6 millimètres.

Mâle, sommet du dernier segment abdominal trilobé, le lobe médian concave et incliné dans la cavité anale.

MINDANAO, Davao (*Baker 8564*).

Oides ovalis sp. nov.

En ovale allongé. Jaune pâle brillant, yeux, sommets des mandibules et quatre derniers articles des antennes, bruns ou noirs, le septième article des antennes est plus ou moins rembruni.

Labre largement et peu profondément échancré, garni de poils assez nombreux ainsi que l'épistôme, ce dernier est surmonté d'une carène triangulaire et convexe; les calus surantennaires sont ovales, convexes, ils sont limités en dessus par un sillon profond en forme d'accolade, le vertex est creusé d'une large impression triangulaire, plus profonde dans son milieu qui est traversé par un sillon longitudinal.

Pronotum transversal, environ deux fois et demie plus large que long, rebordé sur son pourtour; les bords latéraux faiblement arrondis, s'élargissant de la base jusqu'au-dessous de leur milieu et convergents ensuite vers le sommet, tous les angles sont obtus arrondis; le bord antérieur est faiblement échancré; la base est oblique en arrière des angles et sinuée sur son milieu, la surface est peu convexe très éparsement et finement ponctuée, marquée en outre de quatre impression, une en forme de sillon transversal longe le milieu du bord antérieur qui se trouve de ce fait assez fortement élevé, deux transversales assez larges mais peu profondes sont situées de chaque coté sur le milieu non loin des bords latéraux, la dernière très petite est placée au-dessus de milieu de la base. Ecusson en triangle allongé un peu convexe et lisse.

Elytres en ovale allongé, plus larges que le pronotum à la base, régulièrement mais faiblement arrondis de la base au sommet, leur surface est convexe couverte d'une ponctuation fine et assez dense; l'impression située sur la partie latérale antérieure est peu profonde, le bord latéral sur sa première moitié est assez largement explané, il est retombant ensuite jusqu'au sommet; en arrière de l'écusson la suture est longée sur une faible longueur par un sillon ce qui la fait paraitre élevée. Repli épipleural court et très éloigné du bord latéral.

Dessous jaune pâle ainsi que les pattes; ongles roux. Longueur, 7 á 8.5 millimètres; largeur, 4.25 á 5 millimètres.

LUZON, Mount Maquiling (*Baker 2074, 2427*); Mount Banahao (*Baker 4695*).

L'individu recueilli au Mount Banahao est plus pâle, les antennes sont à peine rembrunies sur les deux derniers articles seulement, l'impression frontale est plus accentuée, les bords latéraux du pronotum sont moins nettement arrondis et plus anguleux enfin la ponctuation des élytres est plus fine, mais je ne crois pas qu'il appartienne à une autre espèce.

Dercetes variipes sp. nov.

Jaune d'ocre brillant; deux derniers articles des antennes bruns, sommets des mandibules noirs; le tiers apical des tibias antérieurs, le quart environ des tibias intermédiaires et les tarses de ces deux paires de pattes brun noir, le sommet des tibias et les tarses postérieurs très faiblement rembrunis; tous les ongles roux fauve.

Antennes grèles, filiformes, atteignant le milieu des élytres, le deuxième article ovalaire de moitié moins long que le troisième, le quatrième aussi grand que les deux précédents réunis et plus long que les suivants qui sont égaux entre eux. Sillon transversal profond, lisse, anguleux dans son milieu, quelques rides droites partent de ce sillon et remontent vers le vertex.

Pronotum transversal, environ deux fois et demie plus large que long, finement rebordé sur son pourtour; le bord antérieur est échancré et parallèle à la base qui est arrondie; les bords latéraux sont très faiblement arqués et convergent en avant; les angles antérieurs sont épaissis, saillants et forment une petite dent en dehors, les angles postérieurs sont obtus. Le surface est convexe et lisse. Ecusson triangulaire faiblement convexe, lisse.

Elytres parallèles sur le premier tiers, faiblement dilatés ensuite en arrière et séparement arrondis au sommet. Surface fortement convexe, marquée d'une impression oblique très nette en dedans des calus huméraux, et de deux autres latérales situées vers le premier tiers; de chaque côté de la suture, sur sa partie antérieure, se remarque un sillon assez grossement ponctué au fonds, s'arrêtant à la dépression transversale; tout le reste de la surface est couvert d'une ponctuation assez serrée, fine et régulière.

Dessous un peu plus clair que le dessus, garni d'une pubescence peu serrée très fine et courte. Les pattes sont plus densé-

ment pubescentes, le premier article des tarses postérieurs est aussi long que les trois suivants réunis. Longueur, 7 millimètres; largeur, 3.75 millimètres.

LUZON, Laguna, Mount Maquiling (*Baker 2428*).

Sermyloides banksi Weise.

Sermyloides banksi WEISE, Philip. Journ. Sci. § D 8 (1913) 231, ♂.

Femelle, antennes filiformes atteignant le tiers postérieur des élytres, les troisième et quatrième articles grands égaux, les suivants plus courts. La face de la tête est un peu moins concave que chez le mâle. Le labre est largement bordé de blanc.

LUZON, Mount Banahao (*Baker 4688*).

ILLUSTRATION

FIGURE 1. *Oides bakeri* sp. nov.

ERRATA

VOLUME 26

Page 418, insert at bottom of page, *Type locality*.—Surigao, Surigao (*Baker*).

VOLUME 27

Page 90, line 33, for *hirtifrons* read *argentifrons*.
Page 426, line 11, *for* (Philippinen) *read* (Borneo und Sumatra).

INDEX

[New generic and specific names and new combinations are printed in clarendon; synonyms and names of species incidentally mentioned in the text are printed in *italic*.]

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